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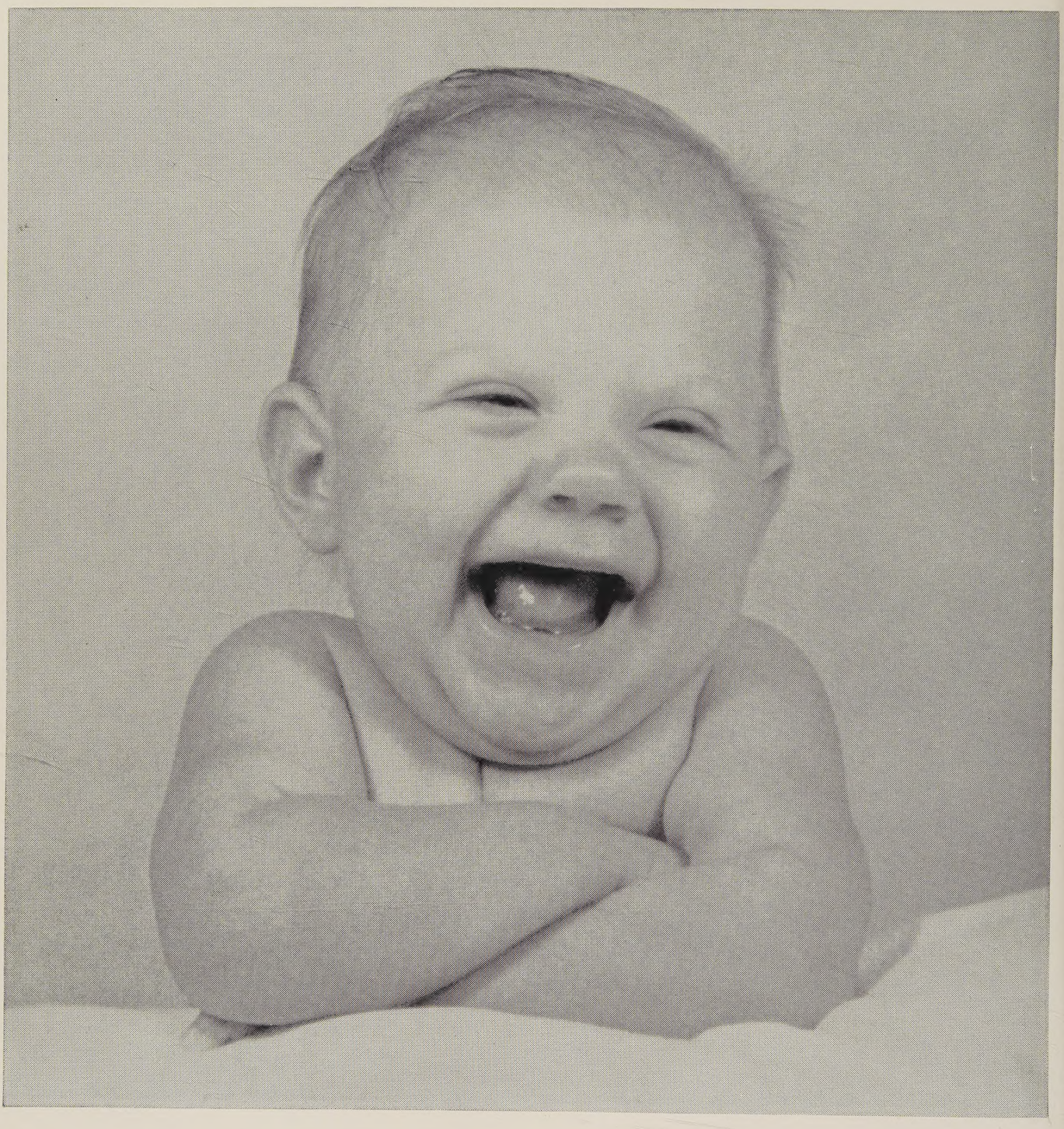

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THE ILLINOIS TECHNOGRAPH

Volume 74, Number 8 **May, 1959**

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Cover . . .

With graduation still fresh in the minds of our seniors and tantalizing the rest of us there is much to which we may look forward. Jerry Hill has presented some of what may be in store for those who have ability and initiative.

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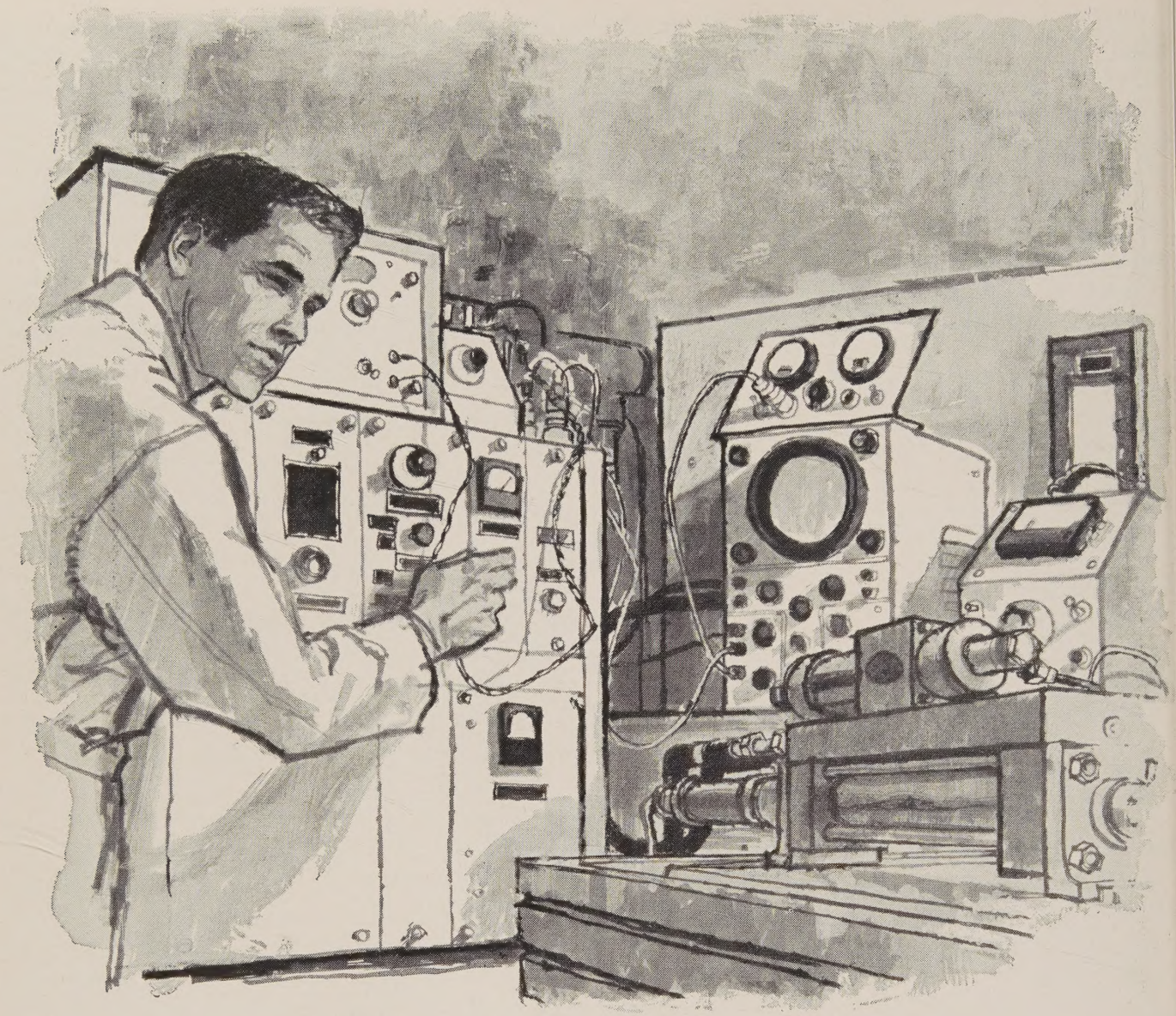

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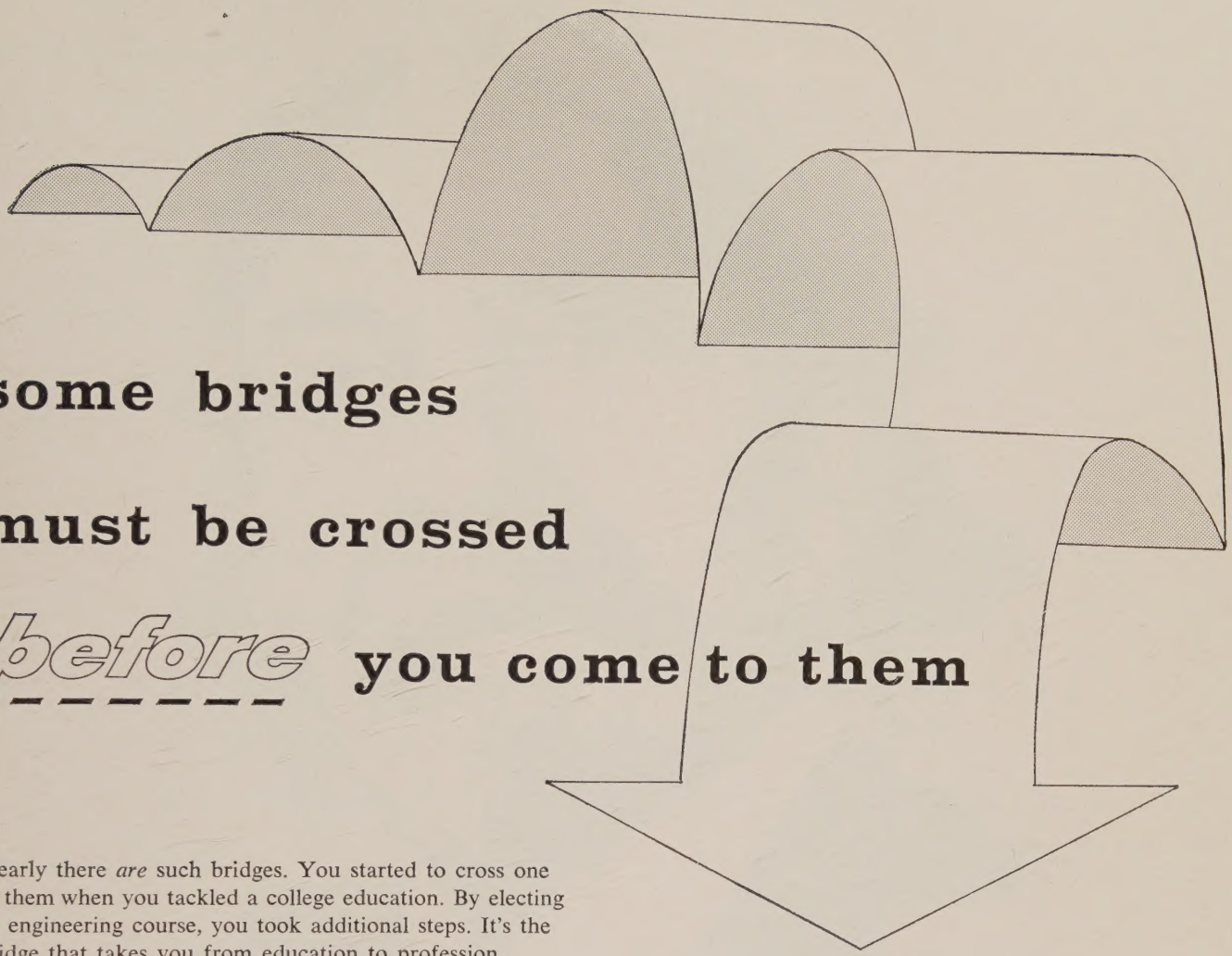

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Thorstein Veblen...on the place of science

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"To modern civilized men, especially in their intervals of sober reflection, all these things that distinguish the barbarian civilizations seem of dubious value... futile in comparison with the achievements of science. They dwindle in men's esteem as time passes. This is the one secure holding-ground of latter-day conviction, that 'the increase and diffusion of knowledge among men' is indefeasibly right and good. When seen in such perspective as will clear it of the trivial perplexities of work day life, this proposition is not questioned within the horizon of western culture, and no other cultural ideal holds a similar unquestioned place in the convictions of civilized mankind."

—*The Place of Science in Modern Civilization, 1906*

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In Closing . . .

With this, the May issue, the year 1958-59 is formally completed for the Illinois Technograph. We realize that publication this year has been behind, and this issue, while late, has been produced for your benefit. In order that you might receive it before school begins next year we have taken the liberty of mailing it to your home address.

The staff and I hope this will renew your faith in our magazine as we feel it has something to offer you. The first issue for next year is being prepared over the summer, so the problems with which we were confronted this year will not arise again.

We wish to thank you for your patience and hope that any of you having an interest in technical writing or editing will contact us next year.. We would be glad to have you on our staff.

W. D. P.

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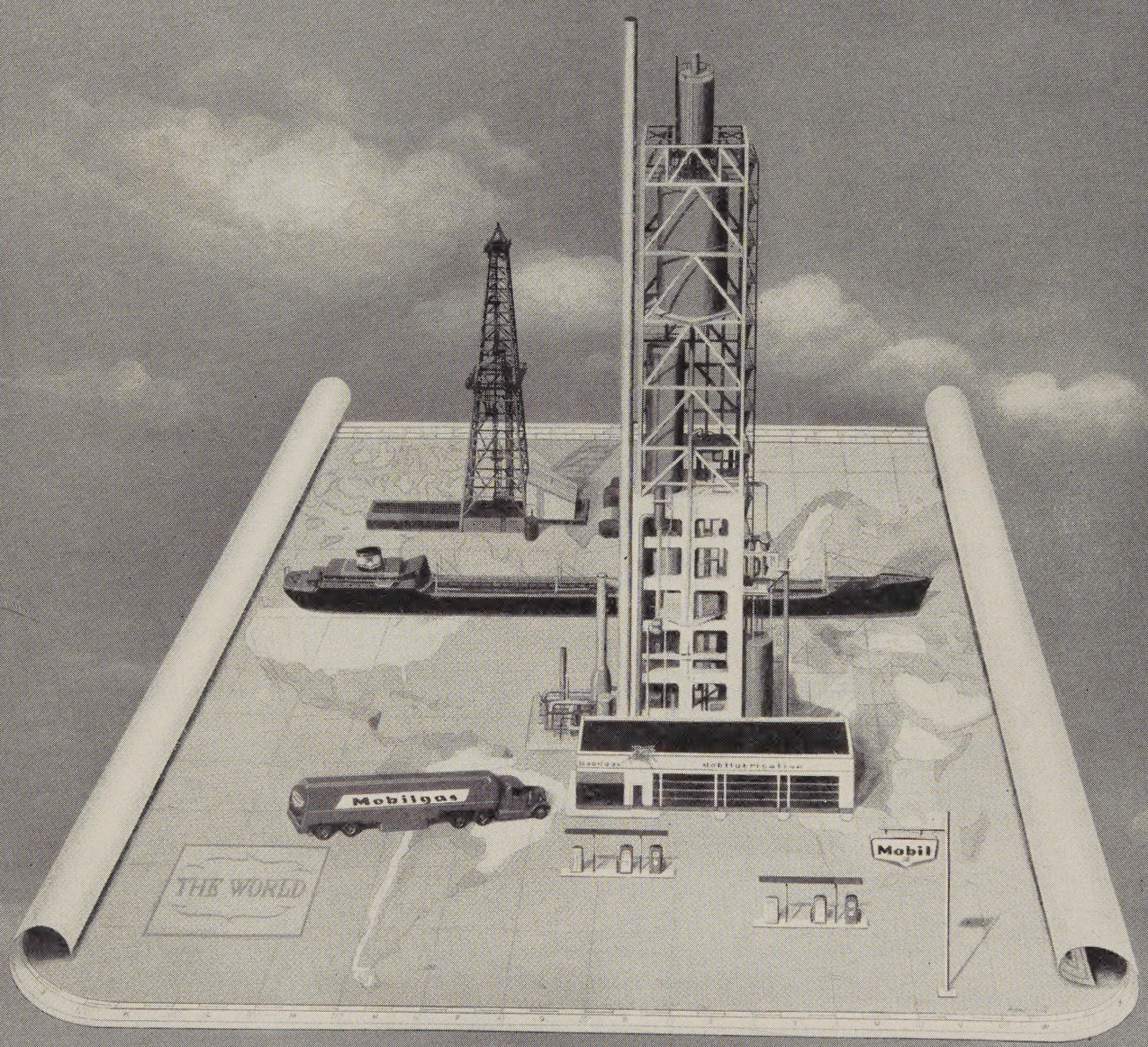

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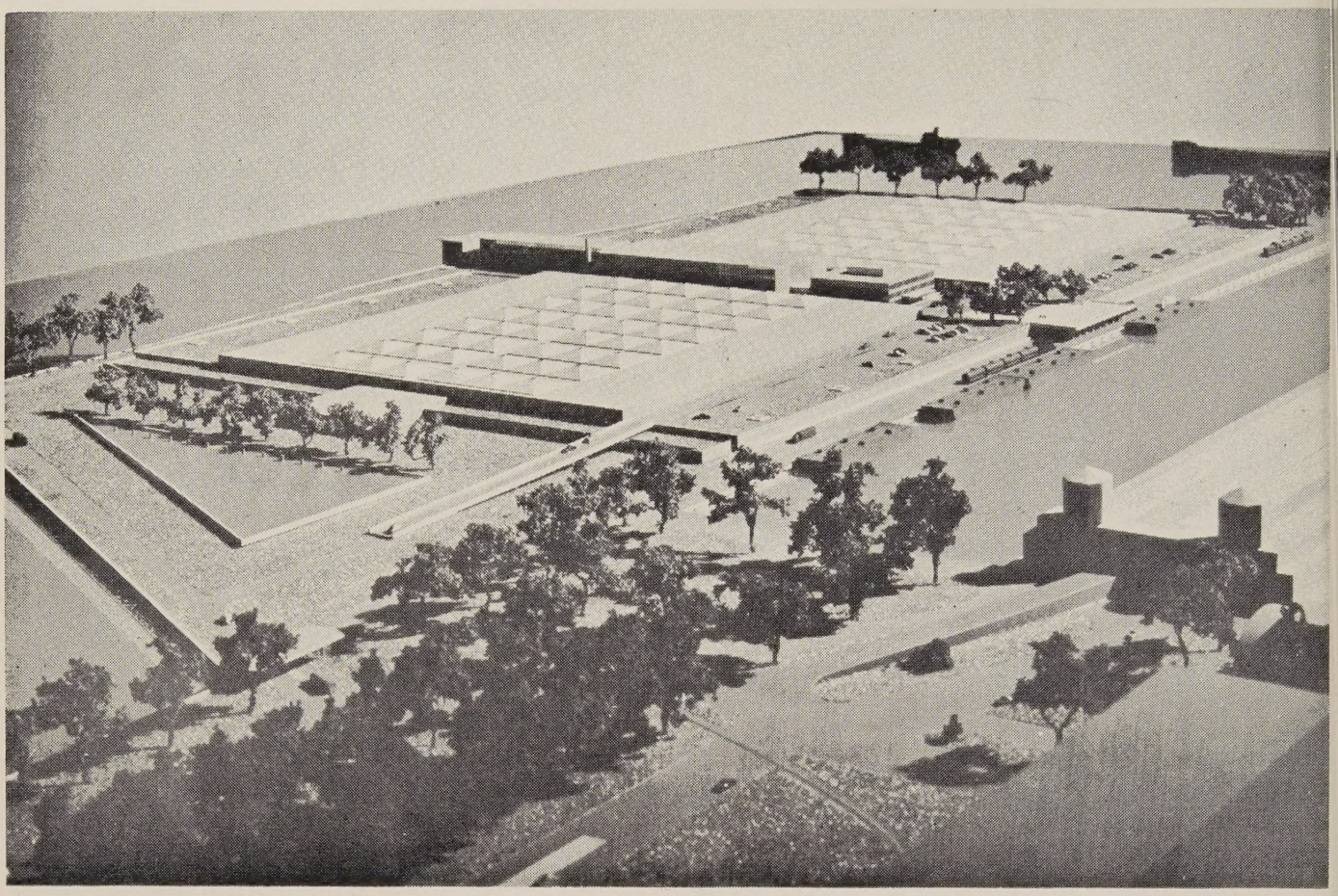


The Central District Filtration Plant

By Mike Murphy

Editor's Note: This article was written for the Navy Pier Issue, however, there was no space for it at that time.

In about two years the Central District Filtration Plant will be completed. It will be, by far, the world's largest municipal water filtration plant. Based on the usual filter rating of two gallons of water per square foot per minute this new filtration plant will have a capacity of 960 mgd (million gallons per day).

This new filtration plant will provide water to about 3,000,000 people residing in the northern two-thirds of Chicago and its adjacent suburbs. The cost of the project is estimated at approximately $90,000,000. Along with the South District Filtration plant, crystal clear filtered water will be provided to more than 4,600,000 people in the Chicagoland area.

Plant Location

The Central District Filtration Plant is located 400 feet north of Navy Pier and from 500 to 1500 feet east of Lake Shore Drive. Early studies hinted that it might be desirable to provide separate filtration plants for the Central Water District and for the North Water District. However, upon further investigation of construction and operating costs, it was found that considerable economy would result by building a single plant. Even though the construction costs of two smaller plants would be less than that of one larger plant, the overall costs including interest and amortization of construction costs, were more than $140,000 per year less for the single plant. Other advantages of building a single plant at the Central District site are: the plant will be close to the existing tunnels from the Denver and Carter Harrison Cribs, from which the unpurified lake water would normally be taken; a direct lake intake will be provided to the low lift pumps; the south wall of the cofferdam is designed so that bulk chemicals can be delivered by barge; and connection can be made quite easily to the existing railroad tracks in the vicinity thus providing another means by which chemicals and other operating supplies can be delivered to the plant.

The plant construction consists of three major divisions of work; the preparation of the site, the construction of connecting tunnels, and the construction of the plant structures themselves.

The first step in building this huge filtration plant was the construction of a cofferdam. This job actually dewatered 67 acres of Lake Michigan. On this tract of land the plant structure would be later constructed. The completed cofferdam is believed to be the

largest one ever built. The walks are of two types of construction. The west, north and east sides are of the dike type construction. This consists of an impervious clay core with small stone facing on the inside and with large stone facing on the lake side. The large stones above the lake level are Bedford Limestone which give a pleasing appearance.

The entire length of the south wall was made of the cellular type of construction. This type was selected for the south wall because it provides an unobstructed slip between the plant and Navy Pier. A dock is to be constructed on this wall and ships will be able to unload chemicals and other operating supplies.

The center portion of the north wall was offset to permit the construction of a direct lake intake to the low lift pumping station. This will be removed when the connections are completed. The offset portion of the wall was built of the cellular type of construction because this type is easier to remove.

The removing of soft materials and the placing of one million cubic yards of sand over most of site was also part of the preparation.

The cofferdam contract amounted to $6,597,510.00. Work began in 1952 and was completed in 1955.

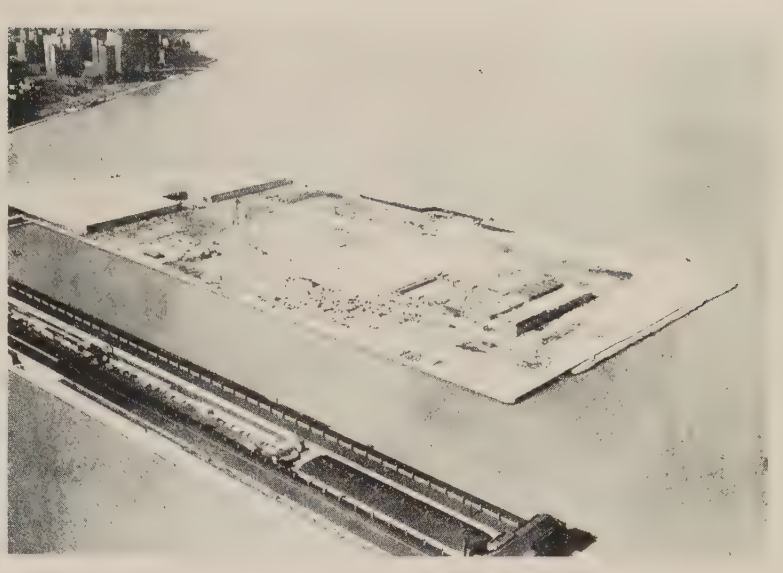
Another important phase in the construction of the new filtration plant is the building of tunnels. Three tunnels have to be constructed. One is to be a 20 ft. tunnel which will carry raw water (not-filtered) from a crib out in the lake to the filtration plant. The tunnel is not connected directly to the crib but to an existing 16 ft. tunnel. This existing tunnel is connected to Dever Crib. A 10 ft. existing tunnel from Harrison Crib joins this 16 ft. tunnel. Both the 16 ft tunnel and the 10 ft. tunnel are then going to be connected to the 20 ft. tunnel now under construction.

Also under construction are two 16 ft. tunnels which will carry the filtered water to the various pumping stations.

These tunnels will have an approximate length of six miles. The cost of the tunnel work except for the connections will amount to $12,696,640. At present about 15% of the tunnel is completed.

The plant structures of this filtration center fall into several classifications. The filtered water reservoir which has a capacity of 68 million gallons was the first to be completed. The cost of this particular structure was $3,918,582. The major units of construction were: 19,000 timber piles, 47,000 cubic yards of concrete and 8,400,000 pounds of reinforcing steel. This structure was completed in the summer of 1957.

The next phase of the construction



Aerial view of the Central District Filtration Plant with the Navy Pier shown in the foreground to the south.

View of mining operation in water tunnel showing a section cut through rock 240 feet below the level of Lake Michigan before being lined with concrete.

"Jungle of Piles," a portion of the 120,000 piles being used to support the substructures for the Central District Filtration Plant north of Navy Pier.

was the filter substructures. These cost approximately $9,867,000. The filter substructures are of the two level type with the filter boxes above and the clear wells below. The clear wells have a total capacity of approximately 60 million gallons of filtered water. The filters are of the dual type with a center wash water gullet. Each half of each filter has its separate manifold below the filter floor. The major items on this contract are 34,000 timber piles, 92,000 cubic yards of concrete, 20,000 000 pounds of reinforcing steel and 1,000,000 pounds of castings.

Following this is the construction of the settling basins. The settling basins structure wil lalso include the slow mix channels. The slow-mix channels are of the around-the-end type. Each of the four channels will have mixers of the paddle type with provisions for varying the speed of rotation as desired. The basins are of the two level type with scrapes to be installed on the upper level only. Provision will be made, however, so scrapers can be installed on the lower level later if this is found desirable. The settling basin structure will cost approximately $11,00,000.

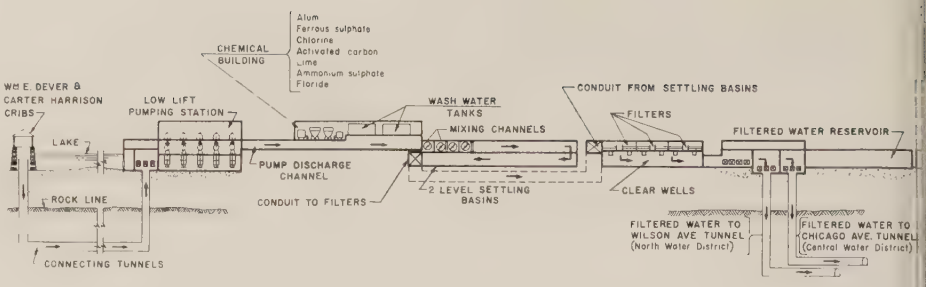
The building to be constructed is the headhouse. Included within the headhouse are the low lift and wash water pumps, the electrical sub-station boiler plant, chemical building, offices, shops, wash water tanks and auxiliary equipment.

Plant Operation

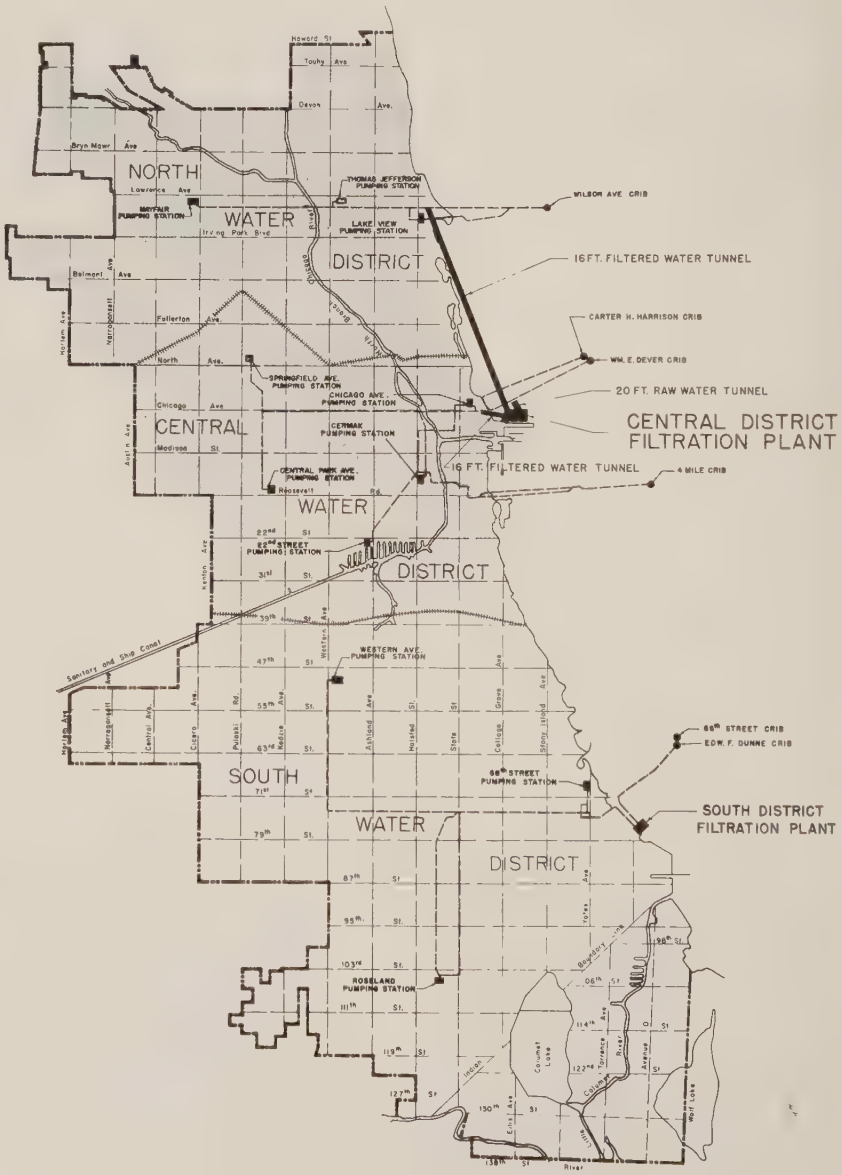
The Central District Filtration Plant is of the rapid sand filtration type and its operation is as follows: During normal plant operation, water is taken by means of the Denver and Carter Harrison Cribs and then flows through connecting tunnels to the low lift pump intakes. The six 260 mgd and two 170 mgd pumps elevate the water about 15.5 feet to the pump discharge channels from where it flows into conduits passing below the chemical building where the following chemicals are added: aluminum sulphate or a combination of ferrous sulphate and chlorine, to coagulate the impurities in the water; activated carbon, to remove objectionable tastes and ordors; lime, to lessen the corrosion in the distribution system; ammonium sulphate, to prevent chlorinous tastes; and flouride, for dental purposes. Chlorine is also applied at various points to make the water bacteriologically safe.

The water next flows from the chemical building through conduits to the mixing basins where the chemicals are thoroughly mixed with the water and a floc is formed by the interaction of the chemicals and the impurities in the water. The water then flows into setting basins where the floc settles to the bottom of the basins and is removed in the form of a sludge. The settled water from the basins now flows to tht filters where the remaining impurities in the water are removed.

The filter consists of about 20 inches of gravel, 24 inches of uniformly graded sand and an underdrain system. The filtered water then flows through regulating and measuring devices to the clear well under the filters and then to the filtered water reservoir which is located at the west end of the plant. The water is now ready to be used by the more than 3,000,000 people who reside in the northern two-third of Chicagoland and its adjacent suburbs.



Flow Diagram



Location of Plant and Area Served

NON-EUCLIDEAN GEOMETRY

By Robert Stehman

Geometry was probably first developed by the Egyptians as a practical system of measurement about 2,000 B.C. It was brought to Greece by Thales (640-546) B.C.), who began to make geometry into a more abstract science. Pythagoras and his followers continued this conversion and improved the science considerably. An important addition was made by Hippocrates, who attempted a logical presentation in the form of propositions deduced from a few definitions.

Euclid receives credit for founding geometry as we generally accept it today. In his *Elements,* Euclid developed the theorems of geometry from twenty-three definitions, five axioms, and five postulates. Euclid's five axioms, or "common notions," are fundamental but indemonstrable principles that are used in all branches of science:

1. Things which are equal to the same thing are equal.
2. If equals be added to equals, the wholes are equal.
3. If equals be subtracted from equals, the remainders are equal.
4. Things which coincide with one another equal.
5. The whole is greater than the part.

It should be noted that these axioms hold true in all geometries, both Euclidean and Non-Euclidean, as well as in algebra and all other forms of science. Euclid's postulates are fundamental principles as are the axioms, but the postulates pertain only to geometry:

I. A straight line may be drawn from any point to any point.

II. A infinite straight line segment may be produced continuously in a straight line.

III. A circle may be described with any center and radius.

IV. All right angles are equal.

V. If a straight line falling on two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles.

Postulate I is commonly interpreted to mean that any two points determine a unique straight line, and postulate II that a line is of infinite length. Postulate V is not as self evident as the other four and has worried geometers ever since Euclide wrote it. Many have tried to prove this controversial postulate and thus place it among the theorems. In the failure to find this proof, new geometries were founded. The development of these non-Euclidean geometries is the subject of this article.

Since this development is an intimate study of Euclid's parallel postulate (the fifth postulate), it is important to have a clear concept of the meaning of the postulate. Consider the line q falling across the lines a and b as in figure 1. Let this be a special case wherein the angle 1 between the lines a and q is a right angle. If angle 2 between lines b and q is less than a right angle, the two angles on the left side total less than two right angles. Therefore, according to postulate five, lines a and b will meet if they are extended to the left. If line b were rotated to position b′ so that angle 2 becomes a right angle, the two angles total exactly two right angles, and are parallel. According to Euclid's definition XXIII, "Parallel lines are lines which, being in the same plane and being indefinitely produced in both directions, do not meet one another in either direction."

Of the work done by early geometers on the parallel postulate we find valuable information in the *Commentary on the First Book of Euclid,* by Proculus (410-485). He first relates Posidoniu's redefinition of parallel lines as lines that are everywhere equisdistant. Proclus, however, on the basis of work done by Geminus (first century, B.C.) showed that lines might not intersect and yet approach each other. Hence Posidonius' definition was rejected. It is interesting

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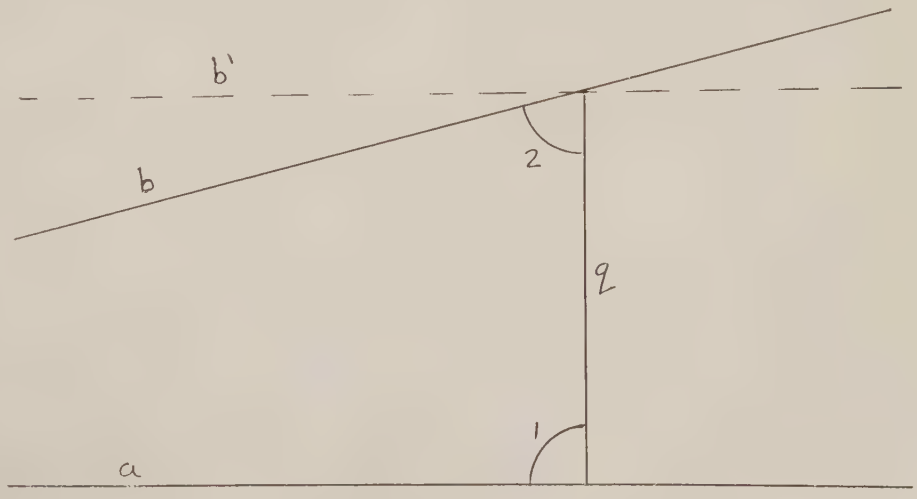

Figure I

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

I've been asked whether non-aeronautical engineers have good prospects for advancement in the aviation industry.

The answer is *yes, definitely!* At Douglas many of our top supervisory people have moved up from other engineering specialties. The complexity of modern aircraft and missiles requires the greatest variety of engineering skills known to industry.

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(Continued from Page 11)

to note that the exact equivalence of the definitions of Euclid and Posidonius can be proved if Euclid's fifth postulate is first assumed, but Proclus would not assume the postulate. He was convinced that it could be proved.

Proclus continues by criticizing a proof of postulate five by Ptolemy by showing that he had argued in a circle by first assuming certain propositions that depend on the fifth postulate for their validity. Proclus then proposed his own proof of the postulate. However, he himself assumes that the distance between two parallels remains less than a certain value, and in this assumption Proclus has committeed the same error as Ptolemy.

A proof by the Arabian Aganis returned to the ideas of Posidonius. In his proof he assumed that equidistant straight lines exist, an assumption that again depends upon Euclid's postulate for validity. Later two other Arabians, Al-Nirizi (ninth century) and Nasir-Eddin (1201-1274), studied further the controversial postulate, but they failed to improve substantially on Aganis' proof.

During the Renaissance, geometers again turned interest to the parallel postulate. The Italian F. Commadino (1509-1575) duplicated the work of Posidonius and Proclus. C. S. Clavio (1537-1612) and G. A. Borelli (1608-1679) gave proofs of the postulate similar to the Arabians' proof. P. A. Cataldi (?-1626) was the first to publish a work devoted entirely to the theory of parallels, but his discussion was also substantially that of the Arabians. Giordano Vitale commented on Proclus' criticism of Posidonius. He demonstrates the equivalence of the definitions of Euclid and Posidonius; however, his demonstration relies upon intuition, not on deduction.

The only original approach to the parallel postulate at this time was the proof of John Wallis (1616-1703). He abandoned the ideas of equidistance employed by his contemporaries and substituted the hypothesis "To every figure there exists a similar figure of arbitrary magnitude." Girolamo Saccheri later commented that Wallis could have simplified his statement to the existence of two triangles of different size whose angles are correspondingly equal. For the circle, a special case of Wallis' original hypothesis, the hypothesis reduces to the third postulate. For any figure that has angles in it, the hypothesis does not hold unless the parallel postulate is true.

All the attempted proofs of the fifth postulate until this time relied upon assumptions that were not valid unless the postulate itself is true. A new approach was introduced by a brilliant Italian Jesuit, Girolamo Saccheri (1667-1773). In his elobrate attempt to "vindicate Euclid," Saccheri assumes postulate five to be false and attempts to reduce this assumption to an absurdity.

The basic figure utilized by Saccheri is a quadrilateral with two adjacent right angles and opposite side adjacent to these angles equal. Figure two is an example. The angles at A and B are both right angles. Sides a and b are equal. Concerning the angles at C and D, Saccheri proposed three hypotheses:

1. They may both be right angles.
2. They may both be obtuse angles, *i.e.* greater than right angles.
3. They may both be acute angles, *i.e.* less than right angles.

He then showed if any one of these hypotheses is true in any one case, that one is true in all cases.

Saccheri continued by proving that Euclid's postulate is true on both the hypothesis of the right angle and the hypothesis of the obtuse angle. Further, he proved that the sum of the angles of a triangle is equal to, greater than, or less than two right angles according to the hypothesis of the right, obtuse, or acute angle. He then drew the conclusion that the hypothesis of the obtuse angle is absurd. For if this hypothesis be true, the sum of the angles of a triangle must be greater than two right angles. Also true is Euclid's postulate. If Euclid's postulate is true, the sum of the angles must exactly equal two right angles. Hence the hypothesis of the obtuse angle contradicts itself and must be false.

Now Saccheri had only to deal with the hypothesis of the acute angle. He proved the fifth postulate defiinitely false on this hypothesis. He then filled many pages with deductions from the hypothesis of the acute angle, but he could find none that was a contradiction. Instead of proving the postulate, Saccheri formulated many of the theorems of the geometry that was soon to defy the postulate.

He desperately grabbed at the proposition that, on the hypothesis of the acute angle, parallel lines have a common perpendicular at infinity. He showed that parallel lines could not have a common perpendicular at any finite distance. Forcing himself to believe that parallel lines should behave in the same manner at infinity as at finity, Saccheri stated that these two propositions were "repugnant to the nature of the straight line." Saccheri preferred to accept this absurd proof than to accept the fact that Euclid's fifth postulate might be refuted.

Fifty years later ,the Swiss mathematician Johann Heinrich Lambert (1728-1777) continued with Saccheri's attempt. His work, definitely influenced by Saccheri, had as its basic figure *a* quadrilateral with three of it angles right angles. Lambert then proposed the three hypotheses of Saccheri concerning the fourth angle. He then promptly disposed of the hypothesis of the obtuse angle with the aid of the usual interpretation of the second postulate.

In his deductions from the hypothesis of the acute angle are several interesting propositions. Lambert, as did Saccheri, noted that on this hypothesis the sum of the angles of a triangle is less than two right angles.

He referred to this deficiency as the defect of a triangle, and showed that the defect is proportional to the area of a triangle.

Another remarkable consequence of the hypothesis of the acute angle demonstrated by Lambert is that measurements would be absolute. On the other hand, if the hypothesis of the right angle is true, all measurements would be relative. In other words, any system of units may be chosen without changing

(Continued on Page 15)

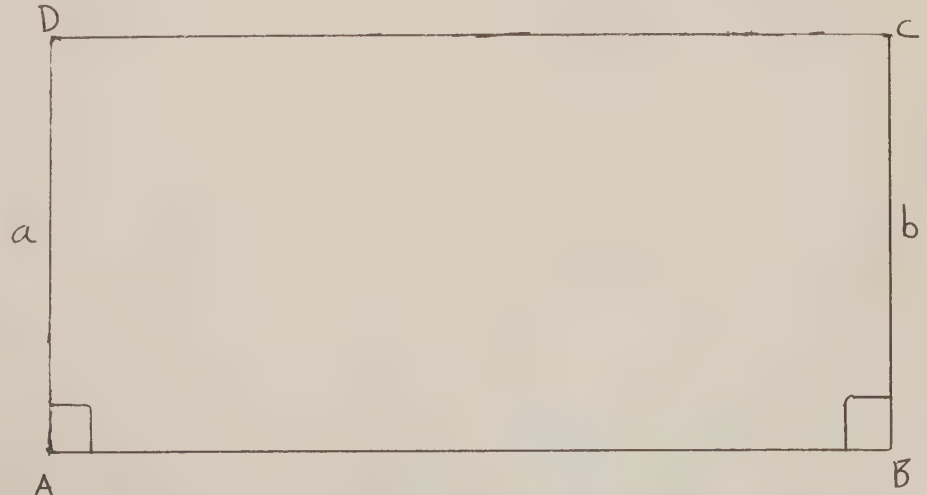


Figure II

Career Opportunities at NASA

NASA directs and implements the Nation's research efforts in aeronautics and the exploration of space for peaceful purposes and the benefit of all mankind. We offer unique opportunities in basic and applied research to scientists and engineers with degrees in the various disciplines.

Briefly described here are representative current NASA programs. Openings exist in all of these programs, at the facilities named.

SPACE TECHNOLOGY

Space vehicle development, including basic planning, development, contract coordination, and operational programming and planning for manned and unmanned satellites. Systems studies for auxiliary power supplies, air regenerative systems, instruments, guidance and communication equipment for space vehicles.

Space probes: Development and operation of vehicles, payload and instrumentation, programming and operation of flight, trajectory, communication systems, and ground support systems for near space and deep space probes.

Beltsville

SPACE MECHANICS

Experimental and analytical study of orbital mechanics including parameters of preliminary and refined orbits, ephemerides, lifetimes, equator crossings and perturbations.

Beltsville; Langley; Ames

PROPULSION AND PROPULSION SYSTEMS

Developmental studies of boosters, launchers, multi-stage engines, guidance and attitude control systems for space vehicles.

Basic research on the interrelationships between electrical, magnetic and thermodynamic energy, and application of such knowledge to space propulsion.

Magneto hydrodynamics: Research on plasma and ion accelerators for space propulsion and auxiliary power systems.

Research on reactors and reactor shielding for aeronautical and space propulsion systems.

Beltsville; Lewis

AERODYNAMICS AND FLUID MECHANICS

Investigation of the thermodynamics and transport properties of gases at high temperatures as encountered in entry into planetary atmosphere.

Research on performance, stability and control, automatic guidance, and navigation for subsonic, supersonic, and hypersonic aircraft.

Aerodynamic heating and satellite re-entry phenomena.

Langley; Ames; Lewis; High-Speed Flight Station

(Positions are filled in accordance with Aeronautical Research Announcement 61B)

INSTRUMENTATION AND COMMUNICATION

Research and development of new sensing devices and instrumentation techniques in electronics, optics, aerodynamics, mechanics, chemistry and atomic physics.

Systems studies and evaluation of control, guidance, navigation, and communication equipment for space vehicles and other high performance applications requiring rugged and compact design.

All Facilities

GEOPHYSICS, ASTRONOMY AND ASTROPHYSICS

Experimental programs and evaluation studies of astronomical and geophysical measurement and scientific equipment used in space vehicle payloads.

Studies of fields and particles in space, investigations of the composition of planetary atmospheres, and development of instrumentation and experimental techniques for these investigations.

Beltsville

STRUCTURES AND MATERIALS

Investigation of the characteristics of high temperature structures and materials. Study of fatigue, structural stability, and other problems of structural dynamics.

Solid State Physics: Study of the elementary physical processes involved in mechanical behavior of materials, such as fractures; the nature of the corrosion process; and physical-chemical relationships governing behavior of materials.

Langley; Ames; Lewis

MATHEMATICS

Application of advanced mathematical techniques to the solution of theoretical problems in aeronautical and space research, involving the use of large modern computing equipment.

All Facilities

RESEARCH FACILITY ENGINEERING

Translation of research specifications into complete experimental facilities, involving mechanical, electrical, structural, architectural and machine design, and construction engineering.

Langley; Ames; Lewis

Please address your inquiry concerning any of the programs listed here to the Personnel Director of the appropriate NASA research center:

Langley Research Center, Hampton, Virginia
Ames Research Center, Mountain View, California
Lewis Research Center, Cleveland, Ohio
High-Speed Flight Station, Edwards, California
Beltsville Space Center, 4555 Overlook Ave., Washington, D. C.

NASA National Aeronautics and Space Administration

(Continued from Page 13)

the properties of the geometry of the hypothesis of the right angle, but the choice of units determines the properties of the geometry of the hypothesis of the acute angle.

Lambert recognized that the geometry of the hypothesis of the obtuse angle has the same theorems as geometry on a sphere. He also realized that the geometry of the hypothesis of the acute angle is the same as geometry on a sphere of imaginary radius, *i.e.* of radius some multiple of the square root of minus one.

However, Lambert failed to find a proof of Euclid's postulate. The problem of finding the proof presented itself to geometers of the late eighteenth and early nineteenth centuries. The French geometers D'Alembert, Lagrange, and Fourier all presented discussions of the parallel postulate but failed to present anything of real importance to the problem. Legendre discussed Lambert's findings on the matter of absolute measurement Intuitively feeling that all measurements were relative, Legendre concluded that the hypothesis of the acute angle must be false.

Laplace left the realm of pure geometry and proved the postulate from the laws of the physical nature of space. He observed from Newton's laws of mechanics and his law of universal gravitation that if all the dimensions, masses, and forces were increased or decreased proportionately, space would remain the same. Thus Wallis' proposition of similiarity is true. Note, however, that Einstein's theories do not have this property of proportionality.

Wolfgang Bolyai (1775-1856) wrote in a letter to Gauss that he had successfully proven the equivalence of the definitions of Posidonius and Euclid. Gauss showed Bolyai's proof to be fallacious. Wolfgang continued work on the theory of parallels. He proposed another hypothesis that could be substituted for Euclid's fifth postulate, "A circle can be drawn through any three points not on a straight line." Friedrich Wachter then proposed a proof of this hypothesis independent of Euclid's postulate. This proof, however, relied on intuition and can not be considered a valid proof of Euclid's postulate.

At this point a new phase in the study of Euclid's parallel postulate began. Until this time, geometers had sought a proof of the postulate. They had had complete faith in the postulate although they could not prove it. Now Carl Friederich Gauss (1777-1855) realized that the geometry of Saccheri's hypothesis of the acute angle is equally as rigorous as Euclid's geometry even though the anti-Euclidean geometry, as called by Gauss, contradicts Euclid's fifth postulate. However, Gauss chose to keep his revolutionary findings to himself and a few trusted colleagues until thirty years later when Lobachevski's work was published.

Gauss did not arrive at this realization in a flash of genius, but only after many years of work trying to prove Euclid's postulate did he come to this conclusion. We find evidence of Gauss' ideas in a portion of his reply of 1799 to Wolfgang Bolyai's letter that was mentioned earlier:

"As for me I have already made some progress in my work. However the path I have chosen does not lead at all to the goal which we seek, and which you assure me you have reached. It seems rather to compel me to doubt the truth of geometry itself."

Gauss' first accomplishment was the redefinition of parallel lines. Through the point in Q in figure three two classes of lines can be drawn. The lines of one class intersect the line a, as does line b." The lines of the other class do not intersect a, as line b′ By Gauss' definition the last line of this second class, line, is parallel to line a.

Gauss then developed the concept of corresponding points. He showed that any set of corresponding points of all the lines through one point form a circle. He next extended the concept to parallel lines and showed that any set of corresponding points of all the lines parallel to a given line form a curve that has many properties in common with a circle but is markedly different from a circle. This curve, known as a horocycle, can be considered to be a circle of infinite radius. Its most remarkable property is that no circle can be drawn through any three points on a horosphere.

Other geometers working independently of Gauss soon began to develop the geometry of Saccheri's hypothesis of the acute angle. Ferdinand Karl Schweikart (1780-1859) proved some of Saccheri's and Lambert's propositions on the defect of the angles of a triangle again. Schweikart showed further that the altitude of a triangle having a right angle can never become greater than a certain length. This length Schweikart then called the constant determining the exact properties of the geometry. He commented that Euclid's geometry would be valid only if this constant were infinitely large. Schweikart sent his findings to Gauss, who replied he had done enough work on the idea to be able to solve any problems if he only knew Schweikart's constant.

Bolstered by Gauss' compliments, Schweikart influenced his nephew Adolf Taurinus (1794-1874) to investigate astral geometry, as Schweikart called it, further. Taurinus, although he had always hoped to find some way of proving Euclid's postulate, developed an analytical geometry of the hypothesis of the acute angle. In this development he makes use of Lambert's concept of the geometry on a sphere of imaginary radius to develop a logarithmic-spherical trigonometry. Taurinus also showed that Euclidean geometry is a limiting case falling between spherical geometry and astral geometry.

Nicholas Lobachevski was the first geometer to develop the geometry of the hypothesis of the acute angle fully and systematically. As early as 1815 Lobachevski was working at a proof of the parallel postulate. By 1823 he had realized the possibility of the existence of a geometry independent of the postulate. In the development of this geometry, which Lobachevski called Pangeometry, he first defined parallel lines in the same manner as did Gauss. He then developed an analytical geometry and a trigonometry from observations upon the horocycle. The formulas of his trigonometry differ only slightly from Taurinus'.

After developing the theorems of Pangeometry, Lobachevski drew three important conclusions from his study:

a. In figures whose sides are small compared with the constant of the ge-

(Continued on Page 23)

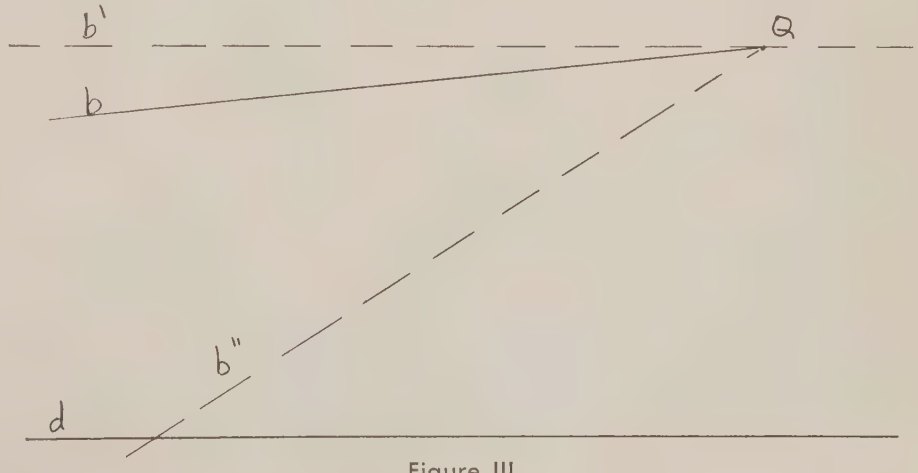


Figure III

RUTH WATT

—Photos by George Knoblock

. . . Technocutie

SUBJECT: Ruth Watt.

ORIGIN: Roseville, Ill.

SPECIES: Freshman (Home Ec type).

HABITAT: Sigma Kappa.

CHARACTERISTICS: Brown eyes, blond hair, 5′ 3″ tall, 105 lbs.

ABILITIES: Dances, sings, swims, and plays golf (cooks and sews, too).

COMMENTS: Wow!

FORESEEN

By Sally Williamson

Editor's Note: This science fiction story won a contest run in a Rhetoric 143 class under Prof. Nuel P. Davis. About twenty students entered the contest, and several of their papers will be published at a later date.

* * *

Peter Ashbrook, an ambitious young medical student, attended classes as usual in the morning, then walked to the hospital for his afternoon intern duty. He saw the usual patients—Mrs. Murphy in room 9 and Sam Jackson in room 10—and Nacombi, that new emergency case that had just come into the room with Sam.

Peter adjusted the sheets carefully over Nacombi's withered body.

Nacombi's eyes were quite green and piercing like the eyes of a cat. They jumped quickly to examine Peter as he worked. The eyes paused, taking in every detail of Peter's face. As they grew large with an indescribable expression, he felt the impact on his entire body.

Later, Peter paused on the corner across from Main Street Park to admire the pretty blonde standing next to him. She stepped off the curb. Peter knew.

"Look, you don't know me," he said to her. "You must think I'm insane or something, but for your own good, go back home! Please don't cross that street."

The surprised young woman stared at Peter. Her face froze. She stepped away from him without speaking.

"Please!" he shouted, grabbing the sleeve of her suit.

"Take your hands off me," she demanded. She sidestepped quickly and walked into the street.

Peter closed his eyes. He heard squealing brakes and a high pitched scream. He had known what would happen. Why wouldn't people believe him?

"Why? Why?" he thought.

His mind returned to those eyes. Why should he think that those eyes had anything to do with the peculiar happening today? He didn't know. He only knew that he must see that man again. Peter turned in the direction of the hospital.

The door of room 10 stood slightly ajar. He hesitated, then pushed it open.

"Nacombi!"

The old man turned slowly. His face was wrinkled and he had gray hair and a moustache. There was nothing distinctive about him except those eyes. Peter shivered.

"You are a nice boy," Nacombi said, clicking his tongue in sympathy. "Too bad it had to be a nice boy."

Nacombi did not appear surprised to see him. "Sit down, boy," he said, "and tell me your name." Peter did as he was told.

"I had to know your name to report to the authority," he said.

Peter thought perhaps the man was delirious.

"I have had this power all my life," he continued breathlessly. "It was given to me. The power to see the future of those around me, even those I did not know. I always knew that this power must be given to someone else when I died."

Nacombi examined his hands folded on the sheets and spoke more slowly. "I am dying now, and yesterday I gave this power to you."

Fear gripped Peter. He ground his teeth together. "What if I do not want it?"

"Unfortunately, you have no choice." Nacombi now had difficulty with his answers. "You must live with it all your life and pass it on to another at your death. Your greatest barrier will be that no one will believe you." He choked. "No one ever believed me." The green eyes closed.

Drained of all energy, Peter walked blindly from the room. He hurried through the streets, but even then he could not avoid visions of the future of those around him. He wanted to shriek with the horror of it. Finally he reached his room and collapsed on the couch.

His roommate entered a few minutes later, dropped his books casually on the nearest chair, and said, "I wonder if we'll have a quiz in anatomy tomorrow. Ah, to know the future . . ."

Peter covered his face with the pillow.

He's been on his way up from the day he started work

James C. Bishop got his B.S. in Electrical Engineering from the University of Illinois on June 23, 1953. On July 1, he went to work as a lineman in the Illinois Bell Telephone Company management training program. On July 2, he was "shinnying" up telephone poles.

And he's been "climbing" ever since. A planned rotational training program, interrupted by a stint in the Army, took Jim through virtually every phase of plant operations.

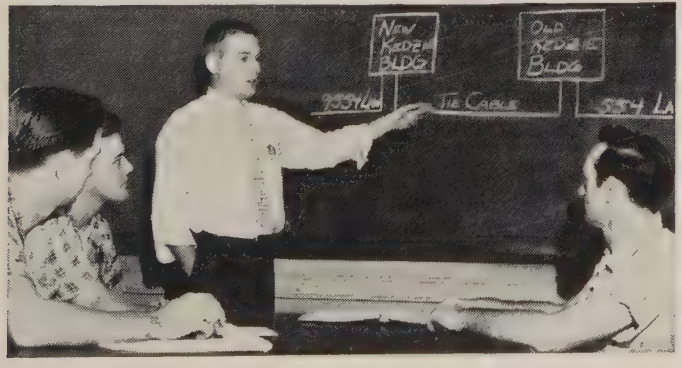
He was promoted to Station Installation Foreman in July, 1957. Then came more training at company expense—in human relations and other supervisory subjects—at Knox College.

Since early 1958, Jim has been Central Office Foreman in the Kedzie District of Chicago, which embraces about 51,000 telephone stations. He has 19 men reporting to him.

"I was hired as 'a candidate for management,'" he says. "I know I'll get the training and opportunity to keep moving ahead. How far I go is up to me. I can't ask for more than that."

* * *

Find out about career opportunities for *you* in the Bell Telephone Companies. Talk with the Bell interviewer when he visits your campus. And, meanwhile, read the Bell Telephone booklet on file in your Placement Office.



Jim Bishop holds training sessions regularly with his men. At left, he discusses cable routes in connection with the "cutover" of his office to dial service. At right, he and a frameman check a block connection on the main frame.

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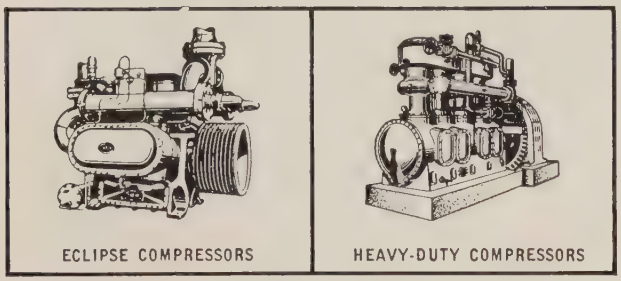

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I.E.: "There are lots of boys and girls who don't neck in parked cars."

C.E.: "Yeah. The woods are full of them."

* * *

American men, they say, never know what to do with themselves when they retire from business. As one of them put it: "I get up early, read the obituary colmn, and if my name isn't there, I go back to bed."

* * *

"I just can't understand those Russians," says the beautiful blonde. "They drink Vodka day and night: all they say is 'Nyet.' When I drink Vodka all I can say is 'Yes'."

* * *

Mrs. Q: "Why are you so jealous of your husband's secretary?"

Mrs. T: "Because I used to be his secretary."

* * *

As the welfare worker picked her way along the crowded slum sidewalk she noticed a woman sitting on a stoop holding a very ugly baby. "My," she murmured to herself, "I never saw a stranger looking baby."

The mother overheard the words and shrugged. "Takes after her pa. He was a stranger, too."

* * *

A newspaper column gave some lovelorn advice to a young lady. "The story that nice men are hard to find is completely untrue. Every city has many of them. The only reason you are still single is because you haven't exposed yourself in the right places."

* * *

Universities are full of knowledge; the freshmen bring a little in and the seniors take a little away, and knowledge accumulates.—Harold Stokes.

START TODAY TO PLAN TOMORROW

By knowing about some of the projects underway at the Babcock & Wilcox Company, an engineer may see his personal avenues of growth and advancement. For today B&W stands poised at a new era of expansion and development.

Here's an indication of what's going on at B&W, with the consequent opportunities that are opening up for engineers. The Boiler Division is building the world's largest steam generator. The Tubular Products Division recently introduced extruded seamless titanium tubing, one result of its metallurgical research. The Refractories Division developed the first refractory concrete that will withstand temperatures up to 3200 F. The Atomic Energy Division is under contract by the AEC to design and build the propulsion unit of the world's first nuclear-powered cargo vessel.

These are but a few of the projects — not in the planning stage, but in the actual design and manufacturing phases — upon which B&W engineers are now engaged. The continuing, integrated growth of the company offers engineers an assured future of leadership.

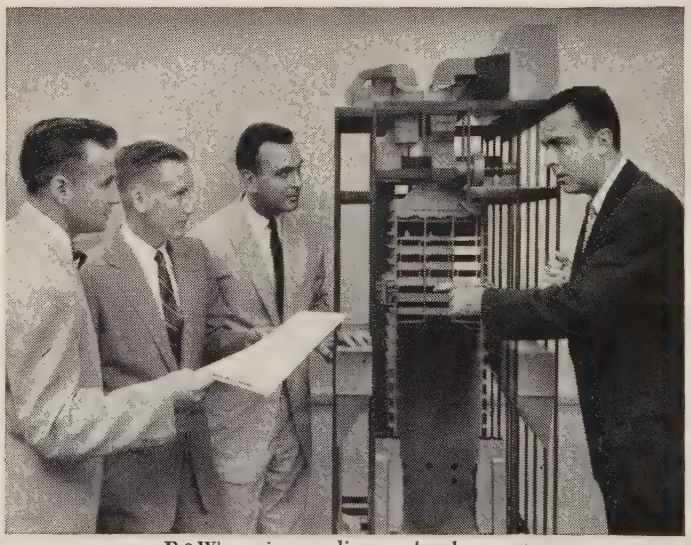
How is the company doing right now? Let's look at one line from the Annual Stockholders' Report.

CONSOLIDATED STATEMENT OF INCOME

(Statistics Section)

(in thousands of dollars)

1954	1955	1956—UNFILLED ORDERS (backlog)
$129,464	$213,456	$427,288



B&W engineers discuss developments in the Universal Pressure Boiler.

Ask your placement officer for a copy of "Opportunities with Babcock & Wilcox" when you arrange your interview with B&W representatives on your campus. Or write, The Babcock & Wilcox Company, Student Training Department, 161 East 42nd Street, New York 17, N. Y.

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N-220

A River
GOES TO COLLEGE

By Michael Sovereign

In a barn-like building on the edge of the University of Illinois campus, a group of students can be seen bending over a large model spillway, complete with running water, roadway and plastic automobiles. But these civil engineering students are not playing. The results obtained from this model over the last three semesters may soon help to bring employment and enjoyment to thousands of downstate residents of Illinois.

The students are members of a class in the Hydraulic Engineering Laboratory, Civil Engineering 356. The spillway model on which they are working is a design for the outlet of a dam which will create Rend Lake Reservoir. The Big Muddy River will be trapped behind the dam, forming a 25,000-acre lake in Jefferson and Franklin counties.

Water Shortage

A reservoir is badly needed in the southern tip of Illinois. Towns such as Benton and Mt. Vernon are dependent on the Big Muddy for their water supply. The use of water from wells is impractical because of its high mineral content. Unfortunately, frequent droughts and floods also limit the usefulness of the river.

The lack of a reliable water supply has hindered the development of badly-needed industry. Franklin County was once the largest producer of coal in the state. Now the fields are declining, with employment down 75%. This decline, along with the consolidation of many small marginal farms, has brought about chronic unemployment in the area. Efforts by Chambers of Commerce and others to attract new industry have been met by the statement that industry needs water.

A few years ago, therefore, the Department of Waterways of the State of Illinois began the study of a reservoir in the Big Muddy River intended to supply 40 million gallons of water daily for nearby towns. The state engineers analyzed available rainfall data, then designed an appropriate dam and spillway. The dam is to be a standard earth structure 44 feet high and nearly two miles long. The spillway specifications called for a tapered trough 500 feet wide and 394 feet long to control the water level behind the dam. The Waterways Department even chose a location near Benton for the dam. Unfortunately, the appropriation for the study did not provide funds for hydraulic model tests of the design. A model test is usually performed to obtain information for better design of the proposed spillway, otherwise a largely empirical problem.

The Department of Waterways published their report, and a copy (one copy of the report) found its way to the Civil Engineering Department of the University of Illinois. Professor J. C. Guillou, Head of the Hydraulic Engineering Laboratory, decided that a continuation of the work with a model study would make a good project for his senior and graduate engineering students. Moreover, while learning hydraulic model theory and practice, the students would be able to perform a service for the people of the state.

When Professor Guillou gave his class the problem of developing the model spillway, their first task was to assimilate the results of preliminary design. The Department of Waterways study had begun with a survey of the heavy rain-storms and floods in and around the Big Muddy Basin. Records of the maximum three-day rainfall in the basin and also in the adjoining area, the largest recorded flood, and the estimated maximum possible rainfall were available in published reports.

From these data, the engineers could estimate the maximum amount of water that the reservoir must contain. Because water does not flow out of reservoirs as fast as it flows in, the maximum rate needed over the spillway was computed from these highest reservoir levels. The resulting calculated flow rates became the design requirements for the spillway.

These data showed that the main spillway must handle the flow produced by the largest recorded storm in the basin, 68,900 cubic feet per second. An auxiliary spillway was therefore included so that the combined units could control the peak flow from the heaviest recorded storm in the adjoining area, when transposed to the reservoir drainage area, namely 165,000 cubic feet per second.

To be effective the combined spillways must remove water rapidly enough to prevent overflow of the earth dam proper itself, this would erode the dam. Also the spillways must keep the water level in the reservoir from rising more than five feet above the minimum level, in order to protect beaches and other recreational facilities. Last, even in dry weather the spillway must allow for maintenance of a certain minimum flow in dry weather to be low enough to prevent stagnation of the river below the dam.

Laws of Similitude

After digesting the information from the state survey, the students were confronted with the task of establishing the ratio of the spillway size to the model size, the scale ratio. They knew that if the model was made too small, the two systems would not behave similarly and their tests would not be reliable. This limitation occurs because the model must not only be geometrically similar to the prototype, but dynamically similar as well. The class could produce geometric similarity by carefully following the designs in their construction, but dynamic similarity is not achieved so easily.

The law of dynamic similitude is a corollary of Newton's Law, force = mass $\times$ acceleration. Accordingly, the

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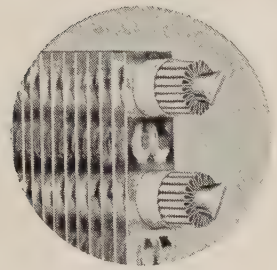

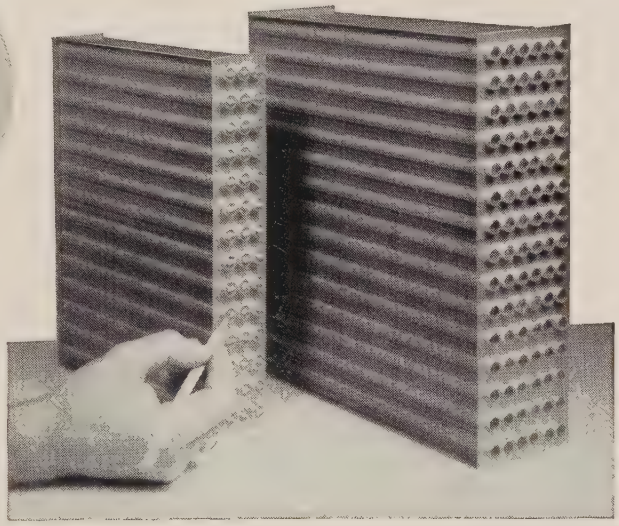

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THE LADY IN RED

By Sheldon Altman

When the Chicago branch of the University inaugurated its subscription campaign at the beginning of October last year, each man buying a subscription to TECHNOGRAPH was buying a chance for a date with the LADY IN RED. As you can see from her picture the fellow getting the date is a lucky guy.

We found her working as a secretary in one of the G.E. offices. Her name is Zita Civics, and besides having charm and personality, she is a LAS Math major with a 4.7 average.

A favorite avocation is teaching Latvian folk dances and songs to high school students. Just to keep her spare moments occupied she is V.P. of the German Club and sings in the choir.

THE LUCKY GUY

The man who escorts Zita to "Music man" and dinner (on TECHNOGRAPH, of course) is Norris Tidwell. He is a southern gentleman who has completed two years of engineering physics at the Pier. He has a 4.0 average and is treasurer of the Society of American Military Engineers.

To work his way through school he operates IBM machines during the summer and works part-time during the year. Before this year Norris was unaware of TECHNOGRAPH because it hasn't been sold in Chicago for quite some time. He is now a confirmed subscriber.

(Continued on Page 15)

ometry (which is quite like Schweikart's constant), we can apply the equations of Euclidean geometry.

b. If all values in the formulas of Pangeometry are replaced by the same values multiplied by the square root of minus one, the formulas are of spherical geometry.

c. It is possible to solve all problems in Pangeometry by the same techniques as applied in Euclidean geometry by substituting the formulas of Pangeometry.

Thus we see that this new geometry is just as likely to be the true geometry of our space as Euclid's. Geometry, therefore, ceases to be an *a priori* science; we must look to the physical properties of space in order to determine which of the two geometries is true. Also, the constant in Lobachevski's trigonometry can not be determined by geometrical deductions. However, astronomical considerations have shown this constant to be very large; therefore over distances with which we are concerned, Euclidean geometry applies.

At this same time another brilliant young mathematician, Johann Bolyai (1802-1861), was working on the geometry of the hypothesis of the acute angle. In 1823, he wrote his father, Wolfgang Bolyai, of his accomplishments. He stated, "I have created a new universe from nothing." Johann's findings were later published as an appendix to the first volume of his father's *Tentamen*. Gauss praised the young mathematician for the appendix, which was entitled "The Absolute Science of Space," but Johann was astounded at Gauss' statement of the work done by other mathematicians, including himself, on this geometry.

Instead of developing formulas that would apply only to the non-Euclidean geometry, Bolyai developed expressions involving the ratio of the diameter of a circle to the circumference. In Euclidean geometry this ratio is denoted by the Greek letter *pi*, but in non-Euclidean geometry the ratio becomes a more complicated expression involving Lobachevski's constant. Thus Bolyai's expressions hold true whether Euclid's parallel postulate is true or not.

Up to this point, of all the mathematicians that had worked on the theory of parallels as related to non-Euclidean geometry none had thought to develop the geometry of the hypothesis of the obtuse angle. Recall, however, that Lambert had shown that this geometry is similar to spherical geometry. Bernhard Riemann (1826-1866), a brilliant student of Gauss, recognized that this geometry becomes fully as valid as Euclidean or Lobachevskian geometry if the interpretations of the first and second postulates are changed: At least one line may be drawn through two points and that line is unbounded but is not infinite in length. The second of these may seem a little paradoxical; however a ready explanation is available. A circle, although it has no end, has a certain length, two times the radius multiplied by *pi*. On a sphere a straight line becomes a great circle, and since Riemann's geometry is similar to geometry on a sphere, this interpretation becomes quite natural.

Riemann first presented the concept of unboundedness but finiteness in his celebrated memoir of 1854, *On the Hypotheses that are the Foundations of Geometry*, which he wrote and submitted at the direction of Gauss. In this memoir Riemann asserts, "The unboundedness of space possesses a greater empirical certainty than any external experience. But its infinite extent by no means follows from this."

The outstanding property of Riemann's geometry is the fact that there can be no parallel lines. Any two lines in this geometry will meet. In fact they will meet in two points that are antipodal. A later mathematician, Klein (1849-1925), sought to simplify this duplicity of points by calling each antipodal pair of points a single point.

Now instead of a single well-defined geometry, there are three geometries, Euclid's, Lobachevski's, and Riemann's. It is impossible to determine which of these geometries is true *a priori*. The answer to the problem can only be found through experimentation and measurement. But in any event, Euclid's geometry will continue to be used, for even if it is not the right geometry, it is very nearly exact for all the measurements with which we are concerned in everyday life. We could apply Reimann's or Lobachevski's geometry equally as well. Our skyscrapers and bridges would stand it; our engineers might not.

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Filter Technique for X-Ray

A filter technique to aid the taking of sharp photographs with an X-ray microscope was announced by Chicago Apparatus Company, laboratory equipment supplier.

An X-ray photomicrograph will make possible the nondestructive inspection of miniature electronic components such as resistors, crystal diodes, photoresistors, ceramic capacitors, transistors, thermistors, and other encapsulated parts.

The time required for such photographs, using the Polaroid Land camera supplied with a General Electric X-ray microscope, is from 5 to 10 minutes, the company said. Magnifications up to 200X are possible, permitting the inspection of fine detail such as micro welds. Dimensions of internal features can be computed in proportion to the enlargement of measurable external features.

Chicago Apparatus' Technical department developed certain filter techniques for X-ray photography. The company was the first in the laboratory field to be appointed a distributor of the GE X-ray microscope.

Blue Wave Hits Market

The long predicted blue wave in paint colorants has now hit the mass market, and the craze for off-whites has vanished as suddenly as it hit in the spring of 1958. Color-trend highlights: marked increases in popularity of blues, rusty corals, sandy beige; turquoise remains in the number one spot, with light-pink second in popularity; major declnes in certain greens, yellow-greens and off-whites.

Paint Resists Blistering

A house paint has been developed which resists blistering under extremely severe conditions. The new paint is chemically engineered to allow moisture vapor to breathe through while shutting out water penetration coming from the outside. It is claimed to be 50 per cent more durable than oil type coatings, dries to the touch in 30 minutes, is ready for second coat in an hour, and can be applied to damp surfaces.

Russian Robot 'Reads'

One million pages per hour can be read by a robot library developed by Soviet scientists. The machine is a book depository with a device for mechanical reading and reviewing of texts in accordance with requests of readers. A special section translates foreign language text. The machine can be linked by wire to readers who have special TV sets for reading. By dialing the "address" of a desired text, they will immediately have it on their screens.

(Continued from Page 21)

forces, masses and resulting motions must be in the same proportion in both systems under consideration. The students knew that the forces affecting the model were gravity, friction and capillary forces. In order to have exact similarity, all these forces in the model would have to be in the same ratios as in the spillway. The students suspected that exact similarity would be impossible to achieve.

From Professor Guillou, they received some encouragement. He told them that as long as the model was not too small, the force of gravity on the water flowing out of the reservoir would be many times larger than the other forces. Once the students had chosen the scale raito, they could check to see that the other forces were negligible.

Froude's Law states that for two systems to have gravitational similarity, their Froude numbers,

$$NFe = \frac{\text{linear velocity of fluid}}{\text{acceleration of gravity} \times \text{length}}$$

must be the same for both systems. The rate of flow of the water supply was limited to four cubic feet per second by the piping in the laboratory. The maximum flow in the spillway would be 68,900 cubic feet per second. From this information the class set up the Froude number for each system and obtained the sale ratio

$$\frac{\text{length of the prototype}}{\text{length of the model}} = \frac{(68{,}900)^{.4}}{(\ 4.0\ )} = \frac{47}{1}$$

The force of friction on the model is negligible as long as the Reynolds number,

$$NRe = \frac{\text{velocity} \times \text{hydraulic radius}}{\text{fluid viscosity}}$$

is more than 800. By solving for the hydraulic radius needed to give a Reynolds number of 800, the students found that friction would not affect the results as long as the water was over 0.09 feet deep in the model.

A similar calculation, involving the Weber number,

$$Nwe = \frac{\text{velocity}}{(\text{capillarity}\ )\ .5}{\text{density} \times \text{length}}$$

showed that capillary forces were negligible. With their calculations completed, the students were ready for construction of the model.

After drawing up the plans, the students began putting together the 15× 25 foot structure. The chief materials were painted wood and concrete. Strangely enough, the wood was used in the model where the concrete will be used in the actual spillway. Conversely, the concrete was used in the downstream area of the model to represent the river bed. Here again was a demonstration of the laws of similitude. The painted wood in the model has a roughness comparable to that of concrete in the actual spillway. The roughness of the concrete in the model approximates that of the irregularities in the actual river bed.

With the completion of the model, Professor Guillou and the students were ready to begin testing. They ran water into the reservoir, filling it so that the simulated river poured down the spillway. By measuring the height of water in the reservoir and simultaneously measuring the amount of water flowing out of the spillway, the class could test the behavior of the spillway. Storms, floods or droughts were reproduced by changing the water flow, and their effects were noted. The flow patterns in the spillway came under careful study. Even color movies were taken for a permanent record of the wave patterns and disturbances. The effect of the bridge piers in the reser-

(Continued on Page 26)

10-SECOND QUIZ for future highway engineers

True ☐ **or False** ☐ ..... Of the 1,050,948 miles of paved roads and streets in the United States, 904,748 miles are surfaced with Asphalt.

True ☐ **or False** ☐ ..... Modern heavy-duty Asphalt pavement is playing a vital role in our $100 billion, 15-year road program that includes 41,000 miles of Interstate Highways.

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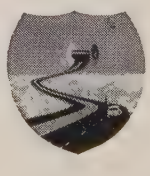


Graphite . . .

THE REFRACTORY WORK HORSE

Edited By The Staff

Manufactured graphite, refractory work-horse in scores of industrial and military applications, is now being produced in flexible fiber and fabric form. National Carbon Company, Division of Union Carbide Corporation, has developed a revolutionary process to convert organic textile forms directly to graphite with a purity in excess of 99.9 per cent.

Any textile form—yarns, braids, and felts, or fabrics that are woven or knit —can be produced in this unique material. In the complex production process, for which patents have been applied, a fiber or fabric such as rayon is graphitized by electrically heating it to a temperature approaching 5400 degrees Fahrenheit. In this thermo - chemical conversion, the crystalline structure of the material is changed to that of graphite similar to manufactured graphite used for electric furnace electrodes, nuclear reactor structures, metallurgical molds, or in any other of graphite's myriad industrial uses.

Graphite's unique combination of electrical, chemical, and mechanical properties—coupled with the wide variety of textile forms now available—gives promise of significant applications of the new material in almost every segment of industry. At ordinary pressures, graphite has no melting point, and sublimes (goes directly from solid to vapor state) only at extremely high temperatures (approximately 6600 degrees F.). Graphite has the unusual property of getting stronger at higher temperatures ,and its tensile strength at 4500 degrees F. is about twice that at room temperatures. Graphite oxidizes in air at temperatures in excess of 750 degrees F. At the low end of the temperature scale, the known properties of graphite fabrics are unaffected by liquid nitrogen at a temperature of –320 degrees F.

Graphite textiles are resistant to attack by acids, alkalies, and organic compounds, except for those of a highly oxidizing nature, and are unreactive with many molten metals. They have excellent electrical and thermal conductivity, and being in flexible form, are immune to thermal shock. Graphite also has well-known lubricating properties that extend its high-temperature applications even further.

The combination of properties and available forms makes applications of graphite textile forms almost as limitless as equipment designers' ingenuity. One field in which experimental quantities of graphite cloth are being evaluated is as a reinforcing agent for various plastics and refractory materials used at high temperatures, such as in the nose cone of space missiles. Plastic and refractory materials subject to thermal cycling are also an excellent potential use for graphite cloth.

Graphite fibers and fabrics can be used to impart electrical and thermal couductivity to non-conducting materials such as plastics, ceramics and even to other textile materials such as glass cloth.

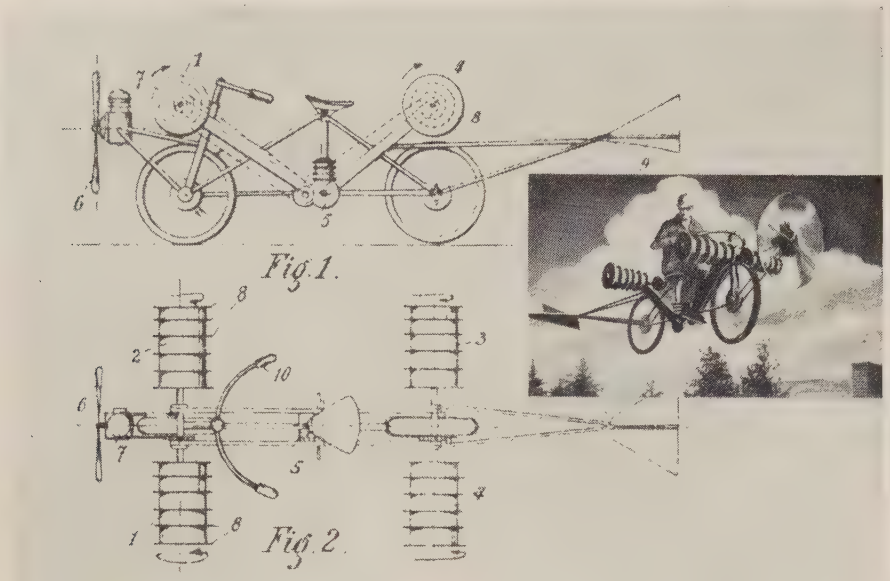
In chemical applications, graphite cloth of the proper mesh is being considered for bag type filters for hot non-oxidizing gases; for equipment to handle corrosive fluids; in electrostatic precipitators, curtain walls, and flame arrestors. Its possible electrical uses include resistance heating elements to put heat exactly where it is wanted, and at very high temperatures. Low-temperature panel heating could include wall units for homes, or perhaps in heated clothing for the first space travelers. Plating, spraying, or vacuum depositing of metals on graphite textiles facilitates making electrical connections.

Electronic possibilities include thermo-electric elements—possibly "doped" with boron—vacuum tube grids, and infra-red emitters. Other potential electrical uses are as static eliminators, and possibly even as a filament material for incandescent lamps.

Possible mechanical applications combine thermal properties with self-lubricity, and include valve packing and gasket materials for high-temperature seals such as those in jet engines. Conveyor belting for high-temperature process equipment is another possibility. A mat form of the material could be used as thermal and/or acoustical insulation.

National Carbon Company is producing experimental quantities of graphite fibers and fabrics for test and evaluation by industry and military personnel throughout the country. An example is a cloth of square weave, 28 by 28 construction, being made in 40-inch width up to 7 feet long and with an average thickness of 0.024 inches. The initial price of experimental quantities of this particular weave is $1.50 a square foot.

MARS outstanding design **SERIES**

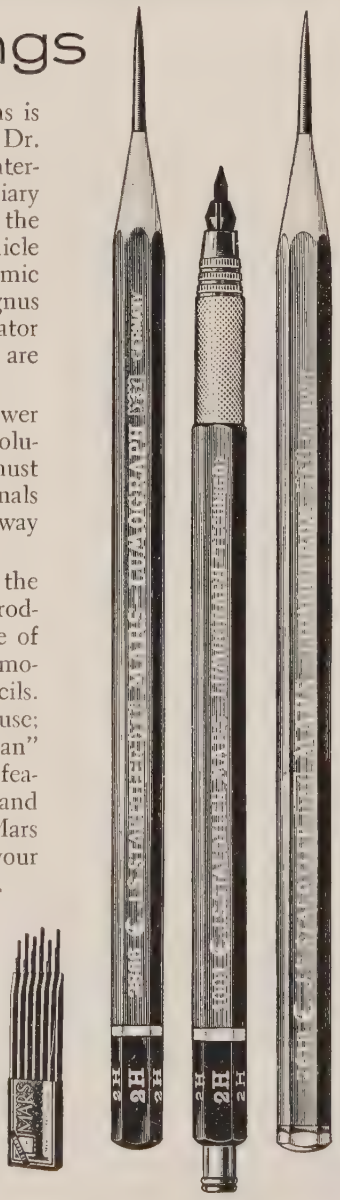


flight without wings

Getting over, rather than around, traffic jams is easy, with this flying motorcycle, says its designer Dr. Manfred Mannheimer, of Newark, N. J. Encountering heavy traffic, it quits the ground. An auxiliary motor rapidly rotates four cylindrical "wings." By the action of the "Magnus effect" these lift the vehicle into the air at 15 mph with 70 hp. The aerodynamic principle involved was discovered by Gustav Magnus in 1858. The cycle's tail-end has a rudder and elevator fin for steering during flight; the rotary wings are telescoped for surface travel.

Whether or not this design will be the answer to traffic congestion, it certainly is an ingenious solution. Aloft or aground, all engineering solutions must originate on the drafting board. And only professionals know how the best in drafting tools smooths the way from dream to practical project.

In pencils, of course, that means Mars, long the standard of professionals. Some outstanding new products have recently been added to the famous line of Mars-Technico push-button holders and leads, Lumograph pencils, and Tradition-Aquarell painting pencils. These include the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman" pencil sharpener with the adjustable point-length feature; Mars Lumochrom, the color-drafting pencils and leads that make color-coding possible; the new Mars Non-Print pencils and leads that "drop out" your notes and sketches when drawings are reproduced.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom *color-drafting* pencil, 24 colors.

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at all good engineering and drawing material suppliers

A RIVER GOES TO COLLEGE

(Continued from Page 24)

voir on the flow of water over the spillway was of particular interest because such effects cannot be easily predicted.

Construction Savings

As is often the case, the results of the model test were not in complete agreement with those predicted from the designs. The students found that the spillway could handle more water than the design maximum. In fact, the elimination of the auxiliary spillway appears feasible. This would result in substantial savings in construction costs. Modifications of the model design based on the results obtained are being planned and will be tested soon.

The people of the state gained in many ways from this unique project. The cooperation of the University and the state saved perhaps $8,500 on the cost of a model test for the spillway. This savings may be multiplied many times by the results of the test in construction savings when the legislature authorizes construction of the dam and spillway. Students in classes over three semesters have learned valuable lessons in hydraulic model theory and practice. This combination of research and teaching with practical problems proved rewarding. In the future perhaps more projects of this type can be undertaken at the University.

Overheard on south campus:

"Your hair is like spun gold—your eyes like two pools—your lips . . . gee, what a mess you must make on a cup of coffee."

* * *

A meek little man walked into a barroom and ordered two drinks from the burly bartender. He drank one of the drinks and poured the other into his shirt pocket. After about ten rounds of this procedure the bartender says, "Pal, why are you pouring the other drink into your shirt pocket?" The little man jumped up into the bartender's face and snarled, "Mind your own business, you big bum, or I shall come over the counter and whale the fire out of you." About that time a blurry-eyed mouse stuck his head out of the pocket and said, "That goes for your damned cat, too."

* * *

Height of confusion: The guy who shouts, "Thank God I'm an atheist!"

* * *

Veteran of the South Seas: "While in the Marshalls I saw the screwiest bird. It lays square eggs and talks."

Freshman: "Oh yeah! What does it say?"

Veteran: "Ouch."

COMMAND DESTRUCT

The flight testing of second generation missiles—more versatile and powerful than their predecessors—requires a device for sure termination of any missile flight that might endanger the test range or surrounding area.

Ramo-Wooldridge engineers, under a United States Army Signal Corps contract, have successfully developed and delivered the first sub-miniature, completely transistorized radio "command destruct" receivers.

Specifically designed for missile flight safety operations, the receiver (AN/DRW-11) can actuate safety mechanisms or destruct devices. It has three command channels, each of which actuates a control relay.

The "command destruct" receiver accepts frequency modulated signals in the UHF radio command control band. It is designed to operate with closer radio frequency and command frequency channel spacing than has been used to date, thus making possible more efficient use of the available radio spectrum.

Compact and rugged, the radio receiver's modular construction permits rapid and complete accessibility to all components. One module houses the basic receiver. The second module contains the three command channels and relays. This integrated package occupies 115 cubic inches, and weighs 4 pounds. The receiver requires no pressurization and operates reliably under the adverse environmental conditions encountered in missile flight testing.

Engineers and scientists interested in being associated with some of the nation's most advanced research and development programs are invited to acquaint themselves with current opportunities at Ramo-Wooldridge. The areas of activity listed below are those in which R-W is now engaged and in which openings exist.

Missile electronics systems
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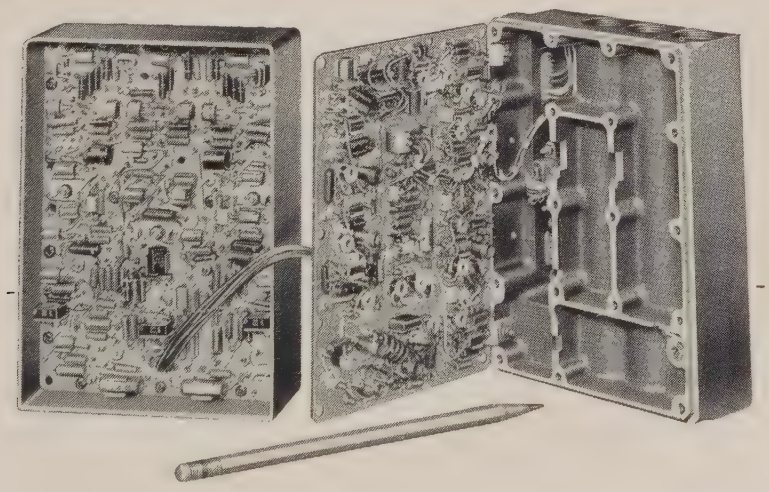
Electronic reconnaissance and countermeasures
Basic and applied physical research

For a copy of our brochure, *An Introduction to Ramo-Wooldridge,* or other additional information write to Mr. Donald L. Pyke.



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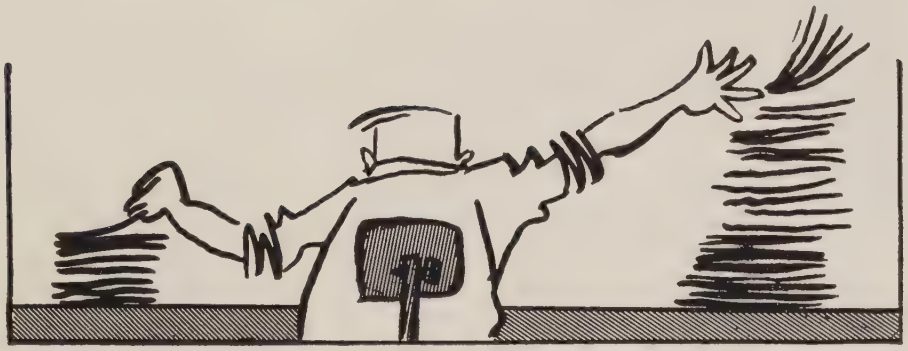
Skimming Industrial Headlines



Edited by The Staff

Dulseal

A transparent adhesive film with delayed setting action to facilitate accurate positioning now is available.

Called Dulseal, the film is being produced as transparent film in sheets and rolls and as a mending tape. With its protective wax coating removed the film becomes just tacky enough to allow approximate positioning. Several hours later it can still be relocated if needed. Left untouched for about 24 hours the film's adhesive "sets" and forms a permanent bond with the paper or cloth to which it was applied.

The .0015-inch thick acetate makes a durable protective coating for maps and other documents that get a lot of handling, in addition to being an excellent mending tape for form drawings. It is washable, waterproof and chemically stable, and recommended for covering outdoor notices and field documents.

Plastic Igloo Marks Triumph Of White Man

There is nothing like an igloo, unless it is an igloo made of plastic. Eskimos will be among the first to admit this.

Brainchild of an officer in the Canadian Department of Northern Affairs and Natural Resources, the new, lightweight igloo marks the white man's triumph over those painstakingly built by the Eskimos for a thousand years.

The new igloo is impervious to summer thaws, bane of the traditional Arctic snow block house. Inside, the temperature can be kept at an even level. The plastic igloo is warmer than one of snow blocks and is unaffected by Arctic winds.

Standing on barren Baffin Island in the Eastern Arctic, the plastic igloo, was constructed by an Eskimo with a reputation as a man who could build a snow igloo in a hurry. He laid the foundation blocks on a circular, two-layer plywood floor. Sandwiched in between the layers was plastic foam. With a saw-knife he shaped the plastic blocks to the proper size. Snow blocks are held together by gravity. But this modern Eskimo used wooden skewers to secure the plastic blocks. A chemical adhesive was used to hold the 18" x 30" blocks together.

Measuring 9 feet high and 18 feet in diameter, the finished igloo can be picked up and carried easily by four men. Its roof will support a 360 pound load. Inside there is silence, despite the 85 mile per hour winds that lash the outside.

In the traditional snow block house the Eskimo whale oil lamp cannot raise the temperature much over 30 degrees. But a small stove, relying on only a kerosene wick, can heat the inside of the new igloo to 105 degrees within several hours, even in the face of an outside temperature of 40 degrees below zero.

No longer does the Eskimo have to live in a drafty tent while he waits for snow that is just right for building an igloo. After a thousand years, the snow igloo is on the verge of becoming as extinct at the wooly mammoth.

Diplomatic Engineers

American engineering personnel are playing an increasing role in foreign fields. Next to tourists, these engineers and technicians represent a large part of the unofficial contact the United States has with other nations. Moreover, the activities of these Americans ultimately extend beyond the technical fields into the economic, social and business life of other countries.

In a time when the United States is doing all in its power to preserve world peace by creating a favorable impression of itself and offering a helping hand to others, it is especially important that American engineers harmoniously work with and live among the peoples of other countries.

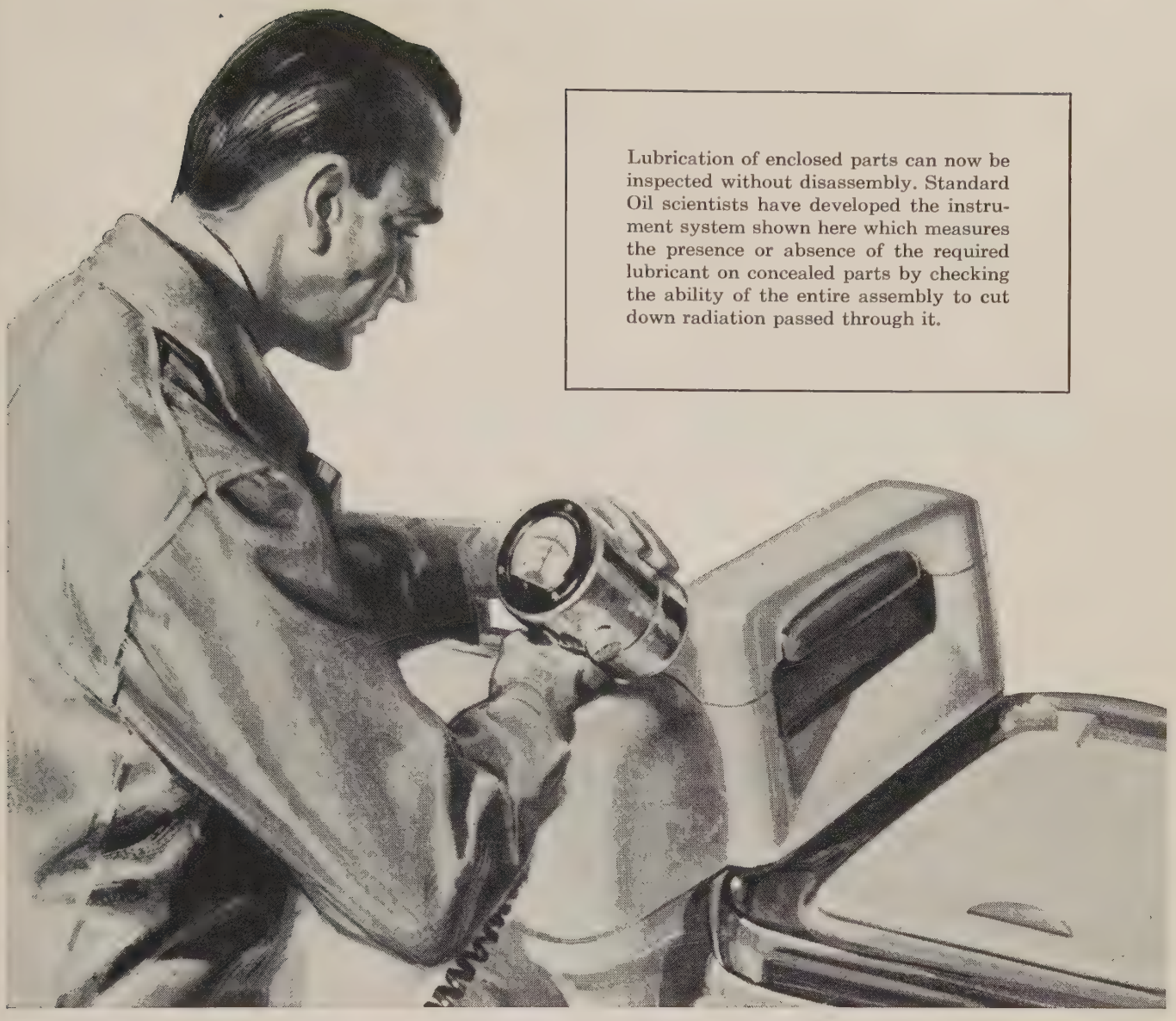
All American engineers and technicians working abroad must acquit themselves well as unofficial representatives of the United States. If they do not, the publicity inevitably generated is harmful not only to the United States but also to the profession of engineering.

The National Society of Professional Engineers, representing more than 50,000 registered engineers, has assumed the responsibility for doing all it can to alleviate this problem in human relationships.

The situation is by no means critical; the objective is to do whatever will help it from becoming so. A necessary initial approach to this area of preventative maintenance is to determine the attitudes which exist in foreign countries among those government agencies, firms and individuals who have a need for the kind of engineering knowledge which they can best obtain from the United States; and, no less vital, the nature of the particular problems American engineers and technicians face in foreign countries when they accept overseas assignments.

NSPE is sending two outstanding and highly qualified professional engineers to South America as a first step in this program which is called Project Ambassador. The attitudes and problems which exist on that continent are primary for three reasons: first, because many American engineers are working there; second, because it represents a tremendous potential demand for engineering assistance; third, because hemispherical solidarity is a key to our national defense.

It is anticipated that the contacts made by the good-will ambassadors in South American countries — and their report to the membership of NSPE — will make possible positive action leading toward increasingly better inter-American relationships between our American engineers and those they serve.



Lubrication of enclosed parts can now be inspected without disassembly. Standard Oil scientists have developed the instrument system shown here which measures the presence or absence of the required lubricant on concealed parts by checking the ability of the entire assembly to cut down radiation passed through it.

How to "see" without looking

At a final inspection station how would you make sure that enclosed parts were properly lubricated? Until recently, if you really wanted to know, you had to remove the housing, disassemble the mechanism—a costly, time-consuming process—and take a look.

But now Standard Oil research has solved the problem with a new instrument system that does away with disassembly. It passes radiation through the assembly and measures the amount that gets through. Inspectors can tell whether or not the proper level of lubricant is present without looking inside.

This remarkable device is just one of hundreds of ways in which Standard has helped industry solve problems connected with lubrication. It was developed by a team of Standard Oil scientists and engineers who saw the need for a new approach to an old problem.

Such creative thinking is the product of the atmosphere in which Standard Oil scientists work. They have the time, the equipment and the opportunity to contribute to the progress of their industry and their country. That is why so many young scientists have chosen to build satisfying careers with Standard Oil.

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THROUGH RESEARCH

New Flight Data Recorder

Development and sale of a new, simplified, lightweight, multichannel flight data recorder was announced by Waste King Corporation. The Waste King unit is a completely self-contained mechanical scribetype recorder for sensing and recording all CAA-TSO requirements except for vertical acceleration. An external accelerometer is provided.

Among the unit's unique features is the inscription of recorded information on a specially coated and almost indestructable metallic tape. The magazine holds 200 feet of tape which will accept 200 hours of flight data recording. Inscription is accomplished by scratching through the coating without embossing the tape so that both sides of the tape can be used for recording. In this way a total of 14 channels of information can be accommodated.

Timing is accomplished without either an actuator or any additional devices. The recording medium is driven at a speed of one foot per hour and is controlled by an accurate escapement mechanims. Sprocket holes, spaced exactly one minute apart, engage the medium with the escapement.

These compact records will form a complete flight history for each aircraft.

Modulated Brake

An important truck brake safety development made possible through the use of air suspension has been reported by General Motors. The new device, known as the modulated brake, permits the highway tractor to approach minimum stopping distance under all load conditions, and reduces the stopping distance to near that of a passenger car.

Air suspension permits the addition of a brake regulating valve which automatically adjusts the braking effort at the rear wheels in proportion to the load on the wheels.

In actual operation this new brake development automatically assures the braking stability of the tractor under all load conditions. At the same time the driver is free to independently control the trailer brakes as required by highway or maneuvering situations. The net result is a marked gain in operating safety.

Glass Paper

Russia has developed a new paper that resists acids, will not burn and will not absorb water. The paper, made of cotton, asbestos and glass fibers, apparently is similar to glass-fiber papers reaching the commercial stage of development in this country.

Eliminate Smog Woes?

A catalytic converter that can be incorporated into automobile mufflers to eliminate 60 to 73 per cent of the exhause hydrocarbons may alleviate acute smog problem in many cities. In smog chamber tests, the converter reduced level or eye irritation in automobile exhausts from "severe" to "none."

New LA-75-A Breaker

Now being manufactured on a production line basis at Boston Works is the LA-75A low voltage air circuit breaker. Tests were completed and final steps were taken recently to complete the range of low voltage breakers to serve the needs of present and future electrical systems in a wide range of industries.

According to Boston Works, the LA-75A offers an exclusive in low voltage air circuit breakers — both electrically and manually charged stored energy closing mechanism on each breaker.

Positive closing, even under maximum fault conditions, is insured by the motor-charged stored energy closing mechanism. Loss of control voltage during closing—as when closing against a fault—has no effect on the closing ability of the stored energy device.

A fractional horsepower motor operated from either DC or AC sprovides the energy to compress powerful closing springs. The closing springs are charged manually by rotating the hand crank permanently fixed to the breaker. In approximately 20 seconds the springs are fully charged and in stand-by readiness to close safely under all conditions within the breaker's rating.

Bronze Castings

More building components and assemblies of cast bronze are among hundreds of new industrial and consumer uses for bronze castings foreseen as the result of new research data compiled.

These more authoritative data point toward new applications for bronze castings leading to safer, stronger and longer-lasting products, such applications which previously were not indicated by available data based on historic record.

This means that the traditional qualities of cast bronze—superior resistance to corrosion and weathering; high structural strength and durability; architectural beauty; and dimensional stability, all combined in a nonmagnetic metal — now can be utilized by the building industry to provide safer, more attractive, longer-lasting and more economical products for industry and home.

from Deep space to Ocean floor

Vought offers this range to the young engineer

At Chance Vought the engineer's assignments range from the depths of the ocean to the farthest reaches of space . . . from hardware operating aboard the Navy's nuclear-armed submarines to space research vehicles still on the boards.

Here the engineer contributes to projects such as the record-smashing *Crusader* jet fighter series . . . antisubmarine warfare studies . . . missile system and space capsule development, details of which are classified.

Under the guidance of the Vought engineer, such weapons take shape. He supervises critical tests, and he introduces the weapons to the men with whom they will serve.

Engineers with many specialties share these experiences. Today, for example, Vought is at work on important projects involving:

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Or write directly to:

C. A. Besio
Supervisor, Engineering Personnel
Dept. CM-16

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

ADVANCED WEAPONS STUDIES AT CHANCE VOUGHT

ASTRODYNAMICISTS. OCEANOGRAPHERS. Their perspectives are worlds apart. But a broad search for advanced weapons is bringing them and other diverse specialists together at Chance Vought.

Opportunities are unlimited for young engineers as Vought advances into new weapons areas.

This advance is the natural outcome of 42 years of successful design and manufacture of high-performance weapon systems. Vought ranks among the nation's topmost sources of fighter aircraft, with the F8U-1 *Crusader* fighter and the F8U-1P *Crusader* reconnaissance aircraft on duty with both Fleets. An even deadlier version of the *Crusader*, the F8U-2N, is scheduled for Fleet service in 1960.

FROM SPACE EXPLORATION TO ANTISUBMARINE WARFARE . . . THEY OFFER BROAD OPPORTUNITIES TO COLLEGE GRADUATES

Today at Chance Vought, development work fans out into virtually every dimension of weapon systems.

ANTISUBMARINE WARFARE (ASW). Vought is engaged in ASW studies under the Office of Naval Research and the Bureau of Aeronautics. Extensive research and development is being done in the vital detection and classification phases. Goal is to bring detection abreast of destruction capabilities.

Vought applies to this work a pre-eminent background in sea-going missiles: 11 years' experience in installing, testing, observing Regulus Fleet missiles; an intimate knowledge of submarines.

ASTRONAUTICS. Vought is advancing the technology of the man-carrying portion of space vehicles. A reputation for "human factors" know-how in advanced aircraft development has won contract assignments for space capsule development. The company is adding research and test facilities for advanced regimes of speeds and heats. And, through "space seminars," the company's most experienced space scientists are orienting the entire engineering organization for space projects.

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WEAPON SYSTEM PLANNING, ANALYSIS. Vought specialists are determining future weapons requirements; defining new areas for closer evaluation. For example, Vought's advanced weapons thinking has branched out into the area of new, sophisticated battlefield weapons. This area has proved promising and well within Vought's weapons development capabilities. Also under way are studies of nuclear-powered missiles and other original applications for today's growth of propulsion possibilities.

In this area, breakthroughs already have been scored in antenna design, in structural design for re-entry heat, and in controls and hydraulics.

Begged, Borrowed, and . . .

Edited by The Staff

Once upon a time there lived in the South a man who worked all day in a stove factory, making stoves. He was, in fact, a stover, i.e., one who stoves. Now this stover's boss not only ran the stove factory but also (this was in (pre-Civil War days) picked up loose change by trading in the slave market. He kept his slaves in the basement of the stove factory, right under where the stover worked.

One day the boss brought in a slave who was sick — had a high temeprature (106°F.) and was delirious. The slave kept shouting and ranting all day, which made it very hard for the stover to work. So when he, the stover, went home that night, his wife said, "My dear, you look tired."

"So would you look tired," he replied, "if you had been stoving over a hot slave all day."

* * *

A car pulled up alongside a couple seated in a car.

"What's the matter?" asked the intended helper, "out of gas?"

"Nope," came thee answer from the inside.

"Engine trouble?"

"Nope."

"Tire down?"

"Didn't have to."

* * *

Some engineering students spend part of their money on liquor and part on women . . . the rest they spend foolishly.

* * *

Legally the husband is the head of the house and the pedestrian has the right of way. Both are fairly safe unless they try to exercise their rights.

* * *

The farmer's boy who used to growl at the cows as he drove them up, now stands wide-eyed at the corner appraising the calves.

* * *

Mrs. Gogarty consoled Mrs. Riley after the death of the latter's husband. "And what did he be dying of?" asked Mrs. Gogarty. "Gangrene," sighed Mrs. Riley. "Well," said Mrs. Gogarty, "thank God anyhow for the color of it."

He walked her to her front door.
She whispered with a sigh,
"I'll be home tomorrow night."
He answered, "So will I."

* * *

Cremators are selling ashes to cannibals to be used as "instant people."

* * *

She: "What's the matter? Don't you love me anymore?"

He: "Sure I do. I was just resting."

* * *

I crept upstairs, my shoes in hand,
Just as the night took wing;
And I saw my wife, four steps above,
Doing the same darn thing.

* * *

The fraternity man smiled as his glance fell upon the sign near the sorority house: "Please drive slowly. The child in the street may be yours."

* * *

And then there was the freshman who thought a neckerchief was a sorority president.

* * *

C.E.: "Do you believe in free love?"

Coed: "Have I ever sent you a bill?"

* * *

An attractive, but not too bright, girl of our acquaintance nearly ruined herself before she discovered that what the doctor ordered was not, as she misunderstood, "three hearty males a day."

* * *

The cutest little dog came to school with Woody every day, but one day they finally separated. The dog graduated.

* * *

A musician was practicing on his saxaphone late at night when the landlord came in: "Do you know there's a little old lady sick upstairs?" asked the landlord.

"No," replied the musician, "hum a little of it."

* * *

Englishman No. 1: "Terribly sorry you buried your wife the other day."

Englishman No. 2: "Had to—dead you know."

* * *

His face was flushed, but his broad shoulders saved him.

We gotta friend who's "visiting" for a spell in the Federal Pen. He writes for their publication under the name of "Ballpoint." That's his pen name, of course.

* * *

Lady (holding cookie above Fido's head): Speak, Speak.

Dog: What shall I say?

* * *

"I must warn you . . . I'm petting against the doctor's orders."

"Gosh, are you sick?"

"No, but my husband is a doctor."

* * *

The wolf wasn't doing so well. After she'd downed her eighth drink he asked, "Don't you ever feel your liquor honey?" "Of course not," she said, "why should I get my fingers wet?"

* * *

A well-adjusted person is one whose intake of pep pills overbalances his consumption of tranquilizers just enough to leave him sufficient energy for a weekly trip to the physiciarist.

* * *

"Answer the door." . . . "Hello, door."

* * *

Luke: Gosh, but I'd like to make your dreams come true.

Lulu: I'll slap your face if you try it!

* * *

Maisie was in a bar having beer when a friend from England walked in.

"Ay say, Maisie, are you 'aving one?"

"No, it's just the cut of me coat."

* * *

Econ lesson for today: Girls without principle draw considerable interest.

* * *

Overheard in Union: "Every time I meet a girl either she's married or I am."

* * *

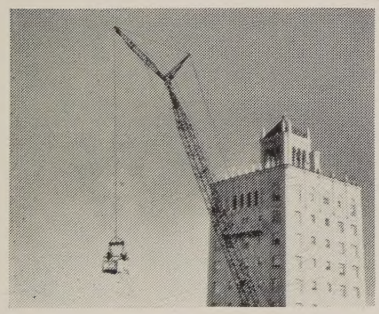
She was so beautiful that when Jim took her home in the taxi he could hardly keep his eyes on the meter.

* * *

One male to another as they watched a girl go by in a chemise: "She looks like a kept woman—like she had been kept under a rock."

Though the building is not yet built, this is a view from one of the apartments.

How to look out a window before the building is up



With 180 "view" apartments to sell, the developers of The Comstock turned to photography to get a jump on sales

A feature of The Comstock, San Francisco's new co-operative apartments on top of Nob Hill, will be the spectacular panoramic views of the Bay area from their picture windows.

How could these views be spread before prospective buyers—before the building was up? The developers, Albert-Lovett Co., found the answer in photography. From a gondola suspended from a crane, color photos were made from the positions of the future apartments. Now, the sales representative not only points out the location of a possible apartment on a scale model, but shows you the view from your window as well.

Photography rates high as a master salesman. It rates high in other business and industry tasks, too. The research laboratory, the production line, the quality control department and the office all get work done better and faster with photography on the job.

Whatever your field, you will find photography can save you time and cut costs, too.

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

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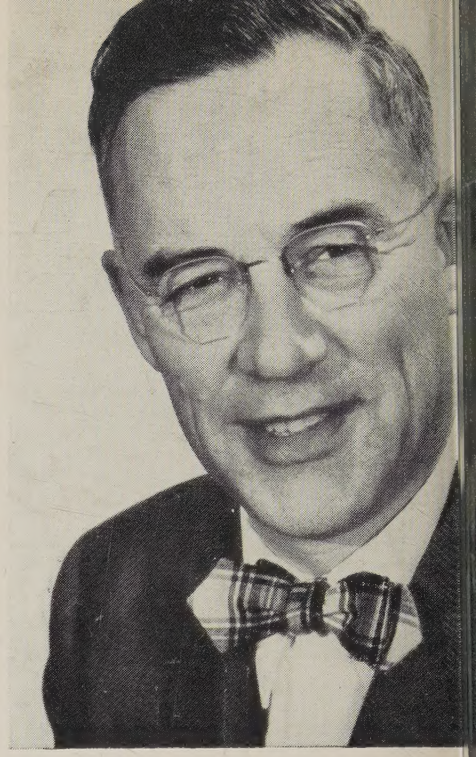
TRADE MARK

One of a series

General Electric interviews Dr. Richard Folsom, President of Rensselaer Polytechnic Institute, to explore . . .



Teaching— A Career Opportunity For the Engineer

Leading educators, statesmen and industrialists throughout the country are greatly concerned with the current shortage of high-caliber graduates who are seriously considering a career in the field of science or engineering education. Consequently, General Electric has taken this opportunity to explore, with one of America's eminent educators, the opportunities and rewards teaching offers the scientific or engineering student.

Q. Is there in fact a current and continuing need for educators in technical colleges and universities?

A. Colleges and universities providing scientific and engineering educational opportunities are hard pressed at the present moment to obtain the services of a sufficient number of well-qualified teachers to adequately carry out their programs. Projected statistical studies show that this critical need could extend over the next 15 or 20 years.

Q. Why is this need not being met?

A. There are probably three main reasons. These might be classed under conditions of financial return, prestige associated with the position, and lack of knowledge and understanding on the part of the college student of the advantages and rewards teaching as a career can afford.

Q. What steps have been taken to make education a more attractive field to engineering students?

A. Steps are being taken in all areas. For example, we have seen a great deal in the newspapers relating educators' salaries to the importance of the job they are doing. Indications are that these efforts are beginning to bear fruit. Greater professional stature is being achieved as the general public understands that the youth of our nation is the most valuable natural resource that we possess . . . and that those associated with the education of this youth have one of the most important assignments in our country today.

Q. Aside from salary, what rewards can a career in education offer as opposed to careers in government or industry?

A. The principal rewards might be freedom to pursue your own ideas within the general framework of the school, in teaching, research and consulting activities. As colleges and universities are normally organized, a man has three months in the summer time to engage in activities of his own choice. In addition, the educator is in direct contact with students and he has the satisfaction of seeing these students develop under his direction . . . to see them take important positions in local and national affairs.

Q. What preparation should an engineering student undertake for a teaching career?

A. In college, the engineering student should obtain a basic understanding of science, engineering science, humanities and social sciences with some applications in one or more professional engineering areas. He should have frequent career discussions with faculty members and his dean. During graduate work, a desirable activity, the student should have an opportunity to do some teaching.

Q. Must an engineering student obtain advanced degrees before he can teach?

A. It is not absolutely necessary. On the other hand, without advanced degrees, advancement in the academic world would be extremely difficult.

Q. How valuable do you feel industrial experience is to an engineering or scientific educator?

A. Industrial experience for a science educator is desirable; however, with a senior engineering educator, industrial experience is a "must". An ideal engineering educator should have had enough industrial experience so that he understands the problems and responsibilities in carrying a project from its formative stages to successful completion, including not only the technical aspects, but the economic and personal relationships also.

Q. What do you consider to be the optimum method by which an educator can obtain industrial experience?

A. There are many methods. After completion of graduate school, perhaps the most beneficial is a limited but intensive work period in industry. Consulting during an academic year or summer is a helpful activity and is desirable for older members of the staff. Younger educators usually need experience in "living with the job" rather than providing consultant's advice to the responsible individual.

Q. Based on your experience, what personal characteristics are possessed by successful professors?

A. Primarily, successful professors have an excellent and growing knowledge of their subjects, are interested in people, and transmit enthusiasm. They have an ability to explain and impart information with ease. They generate ideas and carry them out because they are devoted to developing their fields of knowledge. They desire personal freedom and action.

For further information on challenging career opportunities in the field of science and engineering education, write to: Mr. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

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